Part 135—Operating Requirements: Commuter and On-Demand Operations

This change incorporates Amendment 135–69, Revisions to Digital Flight Data Recorder Rules, adopted July 9 and effective August 18, 1997. This amendment revises § 135.152, amends Appendixes B and C, and adds Appendix F.

Bold brackets appear around the revised or added material. The amendment number and effective date of these changes appear in bold brackets at the end of each affected section.

Page Control Chart

Remove Pages	Dated	Insert Pages	Dated
P–853 and P–854	Ch. 13	P–853 through P–877	Ch. 14
Subpart C	Ch. 12	Subpart C	Ch. 14
Appendix B	—	Appendix B	Ch. 14
Appendix C	—	Appendix C	Ch. 14
		Appendix F	Ch. 14

Suggest filing this transmittal at the beginning of the FAR. It will provide a method for determining that all changes have been received as listed in the current edition of AC 00–44, Status of Federal Aviation Regulations, and a check for determining if the FAR contains the proper pages.

Transportation Policies and Procedures (44 FR 11034; February 26, 1979) when the impact of a regulation will be minimal if adopted, a full regulatory evaluation does not need to be prepared. The following discussion provides an economic assessment of the proposal's anticipated costs and benefits.

Costs

The amendment will allow air carriers and commercial operators to seek authorization for the use of autopilot systems during the takeoff phase of flight. Because the decision whether to seek authorization for the use of autopilot is optional and voluntary, the amendment will not impose any additional costs on certificate holders that operate under parts 121, 125, or 135.

Benefits

This amendment will have positive effects on the safety of air operations. As with any change to operations specifications, the FAA reserves the right to determine whether suggested revisions to an air carrier's operations specifications meet the various criteria and guidelines that will ensure that the current level of safety is met or exceeded.

The use of the autopilot system below 500 feet AGL will enable the pilot to monitor the performance of the aircraft while performing other safety-related functions, such as scanning the outside area for other aircraft. Since less time is spent manipulating the controls, the use of the autopilot also enables the flightcrew to more readily identify any deviations from expected aircraft performance thus increasing the pilot's opportunity to quickly respond to any aircraft malfunctions. Increasing the pilot's opportunity to scan the area outside the aircraft for other airborne traffic, to detect aircraft malfunctions, and to respond more quickly to problems will increase the level of safety.

International Trade Impact Analysis

The FAA has determined that the amendments to parts 121, 125, and 135 will not have a significant impact on international trade. The amendments are expected to have no negative impact on trade opportunities for U.S. firms doing business overseas or foreign firms doing business in the United States.

International Civil Aviation Organization and Joint Aviation Regulations

In keeping with U.S. obligations under the Convention on International Civil Aviation, it is FAA policy to comply with ICAO Standards and Recommended Practices (SARP) to the maximum extent practicable. In reviewing the SARP for air carrier operations and JAR–OPS 1, the FAA finds that there is not a comparable rule under either ICAO standards or the JAR.

Regulatory Flexibility Determination

Congress enacted the Regulatory Flexibility Act (RFA) of 1980 (Pub. L. 96–354) to ensure that small entities are not unnecessarily and disproportionately burdened by government regulations. The RFA requires agencies to review rules that may have a significant impact on a substantial number of small entities. This amendment will impose no additional costs on air carriers; therefore, it will not have a significant economic impact on small business entities.

Federalism Implications

The regulations contained herein will not have substantial direct effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government. Therefore, in accordance with Executive Order 12612, it is determined that this amendment will not have sufficient implications to warrant the preparation of a Federalism Assessment.

In consideration of the foregoing, the Federal Aviation Administration amends parts 121, 125, and 135 of the Federal Aviation Regulations (14 CFR parts 121, 125, and 135) effective June 20, 1997.

The authority citation for part 135 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701–44702, 44705, 44709, 44711–44713, 44715–44717, 44722.

Amendment 135–69

Revisions to Digital Flight Data Recorder Rules

Adopted: July 9, 1997 **Effective: August 18, 1997**

(Published in 62 FR 38362, July 17, 1997)

SUMMARY: This document revises and updates the Federal Aviation Regulations to require that certain airplanes be equipped to accommodate additional digital flight data recorder (DFDR) parameters. These revisions follow a series of safety recommendations issued by the National Transportation Safety Board (NTSB), and the Federal Aviation Administration's (FAA) decision that the DFDR rules should be revised to upgrade recorder capabilities in most transport airplanes. These revisions will require additional information to be collected to enable more thorough accident or incident investigation and to enable industry to predict certain trends and make necessary modifications before an accident or incident occurs.

DATES: *Effective date:* August 18, 1997. Comments on the Paperwork Reduction Act issues presented in this document must be received by September 15, 1997.

ADDRESSES: Comments on this notice should be mailed, in triplicate to: Federal Aviation Administration, Office of Chief Counsel, Attention: Rules Docket (AGC–200), Docket No. 28109, 800 Independence Avenue SW., Washington, DC 20591. Comments delivered must be marked Docket No. 28109. Comments may also be submitted electronically to the following Internet address: 9–nprm–cmts@faa.dot.gov. Comments may be examined in Room 915G weekdays, except on Federal holidays, between 8:30 a.m. and 5 p.m.

FOR FURTHER INFORMATION CONTACT: Gary E. Davis, Air Carrier Operations Branch (AFS–220), Flight Standards Service, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, DC 20591; telephone (202) 267–3714.

SUPPLEMENTARY INFORMATION:

Background

Statement of the Problem

The NTSB submitted recommendations to the FAA to require the recordation of additional parameters on certain fight data recorders. These recommendations were submitted in response to accidents involving two Boeing 737 aircraft that were operated by two different air carriers. Both airplanes were equipped with flight data recorders (FDR's), but in neither case did the FDR provide sufficient information about airplane motion and flight control surface positions during the accident sequence to enable the NTSB to determine a probable cause for either accident.

The history of aircraft accidents and the lack of information that has inhibited proper investigation of their causes is much broader than recent experience with the Boeing 737. Historical records of airplane incidents suggest that additional, reliable data for the entire fleet of transport category airplanes is necessary

The following recommendations were submitted by the NTSB to the Federal Aviation Administration:

I. Require that each Boeing 737 airplane operated under 14 CFR part 121 or 125 be equipped, by December 31, 1995, with a flight data recorder system that records, as a minimum, the parameters required by current regulations applicable to that airplane plus the following parameters: lateral acceleration, flight control inputs for pitch, roll, and yaw, and primary flight control surface positions for pitch, roll, and yaw. (Classified as Class I, Urgent Action) (Recommendation No. A–95–25)

II. Amend, by December 31, 1995, 14 CFR §§ 121.343, 125.225, and 135.152 to require that Boeing 727 airplanes, Lockheed L–1011 airplanes, and all transport category airplanes operated under 14 CFR parts 121, 125, or 135 whose type certificates apply to airplanes still in production, be equipped to record on a flight data recorder system, as a minimum, the parameters listed in ''Proposed Minimum FDR Parameter Requirements for Airplanes in Service'' plus any other parameters required by current regulations applicable to each individual airplane. Specify that the airplanes be so equipped by January 1, 1998, or by the later date when they meet Stage 3 noise requirements but, regardless of Stage 3 compliance status, no later than December 31, 1999. (Classified as Class II, Priority Action) (Recommendation No. A–95–26)

III. Amend, by December 31, 1995, 14 CFR 121.343, 125.225, and 135.152 to require that all airplanes operated under 14 CFR parts 121, 125, or 135, having 10 or more seats, and for which an original airworthiness certificate is received after December 31, 1996, record the parameters listed in ''Proposed FDR Enhancements for Newly Manufactured Airplanes'' on a flight data recorder having at least a 25-hour recording capacity. (Classified as Class II, Priority Action) (Recommendation No. A–95–27).

FAA Response to the NTSB Recommendations

On March 14, 1995, the FAA published in the *Federal Register* a notice of a public hearing, and solicited public comment concerning the NTSB recommendations. On April 20, 1995, the public hearing was held in Washington D.C. Eight speakers from the aviation community made presentations. Copies of the presentations have been placed in the docket for this rulemaking.

After considering the information obtained through the public forum, the FAA responded to the NTSB recommendations. A summary of that response was published in Notice No. 96–7, and is summarized here:

In response to Safety Recommendation A–95–25, the FAA stated that it agrees that Boeing 737 airplanes that operate under 14 CFR part 121 or 125 should be equipped with flight data recorders that include, as a minimum, the parameters referenced in this safety recommendation. This proposed rule would require all Boeing 737 airplanes as well as certain other airplanes operated under 14 CFR parts 121, 125, or 135 having 10 or more seats to be equipped to record the parameters that were specified by the NTSB.

The FAA received enough valid information from the public to determine that the schedule for retrofit completion by December 31, 1995, could not be met. The proposed date would have imposed an extremely aggressive retrofit schedule that, if it were physically possible, would have resulted in substantial airplane groundings and very high associated costs. Furthermore, if operators had been required to retrofit all Boeing 737 airplanes before the end of 1995, each of these airplanes might have had to undergo a second retrofit to meet the expanded requirements that were proposed in response to NTSB Recommendations A–95–26 and –27.

In response to NTSB recommendation A–95–26, the FAA agrees that airplanes still in production should be required to be equipped with DFDR's that record, as a minimum, the parameters listed in the NTSB recommendation.

In response to NTSB recommendation A–95–27, the FAA agrees that airplanes operated under parts 121, 125, or 135 having 10 or more seats for which an original airworthiness certificate is received

Aerospace Industries Association of America, General Aviation Manufacturers Association, Regional Airline Association, Air Line Pilots Association, and the FAA. The NTSB was invited to participate in working group efforts in an advisory capacity. The working group's task was to recommend to ARAC rulemaking proposals or other alternatives that would satisfactorily address the NTSB recommendations. The ARAC could then make one or more recommendations to the FAA, and the FAA would determine whether to issue a proposal based on the ARAC recommendation.

The DFDR Working Group met over the course of several months. While many of the issues concerning flight data recorder upgrades were settled, no formal recommendation was forwarded to the FAA by the ARAC. A full discussion of the issues considered by the working group was included in Notice 96–7.

NPRM No. 96–7

On July 16, 1996, the FAA published an NPRM addressing revisions to digital flight data recorder rules and solicited public comment to the proposed amendments. The proposals were based on meetings attended by FAA, ARAC, and NTSB personnel. Twenty-six commenters responded, each addressing multiple issues. Their comments have been placed in the docket. Although numbered comments in the docket indicate 28 commenters responded, several submittals were duplicates. Comments to the NPRM are discussed in detail in the ''Discussion of Comments to the NPRM'' section of this document.

Supplemental Notice of Proposed Rulemaking, SNPRM No. 96–7A

As a result of some comments received and further analysis within the FAA, the FAA determined that some issues not included in the NPRM, but related to the proposal, should have been included. These issues included: (1) Applicability of the requirements to airplanes placed on the operations specifications of a U.S. operator after a certain date; (2) a compliance date for certain aircraft that must be retrofitted with DFDR equipment as a result of a change in policy announced in Notice 96–7; (3) information regarding airplanes that should be exempted from the requirements proposed in Notice 96–7; and (4) a requirement to use a 25-hour recorder, which is the industry standard, rather than the 8-hour recorder currently required. Because three of the issues were not included in the initial proposal, and because the FAA needed more information to make a determination regarding all four of the issues, the agency published a supplemental proposal on December 10, 1996 (61 FR 65142), and solicited public comment. Six comments were received; they are discussed in detail in the ''Discussion of Comments to the SNPRM'' section in this document. After analysis of all comments received, the FAA has adopted final rule language that includes items proposed in the SNPRM.

Discussion of Comments to the NPRM

Flight Systems Engineering, Inc., comments on the requirement for recordation of lateral acceleration on airplanes with one or two engines. It states that to the best of its knowledge, the ''trade-in'' program to upgrade from dual to tri-axial accelerometers was considered, but is not currently available and it doubts it will ever be. The commenter estimates the cost of the tri-axial accelerometer to be $3,000 per aircraft plus associated engineering and installation costs. The commenter believes that the accelerometer information can be obtained through analysis of other available data. In addition, the commenter states that to require a sampling rate of twice per second (rather than the current once per second) as proposed for certain parameters may generate costs to industry that the commenter does not consider to be cost beneficial.

FAA Response: The FAA acknowledges that this rule will place some economic burdens on operators. According to information received by the FAA, however, the $3,000 per aircraft for a tri-axial accelerometer is a maximum cost for a new unit, which, in practice, the FAA maintains will not be installed in all cases. Rather, modified units will be used wherever possible. The FAA does not agree that the commenter's proposed method of obtaining the information through analysis is a reasonable alternative that would satisfy the NTSB recommendation. No changes have been made as a result of this comment.

AVRO International Aerospace comments that the proposed list of parameters appears to have been developed to address a specific type of airplane that has experienced a small number of accidents, and that the proposed list of parameters may not be the most appropriate for general application. AVRO also states that the European codes have been formalized for adoption through JAR Ops and that it considers the FAA's action to extend requirements beyond the EUROCAE ED–55 standards (ED–55) without a full consultation with JAA authorities to be contrary to the spirit of the JAR/FAR Harmonization program.

FAA Response: The FAA acknowledges that the requirements proposed in the NPRM could appear to have been developed to address a specific type of airplane, and expanded to merely include all airplanes. However, the parameters proposed to be recorded involve functions of all airplanes, and may provide data over a wide range of incidents and accidents. Accordingly, in response to the NTSB recommendation, the FAA has included all transport category airplanes in this rulemaking action. The FAA disagrees that extended U.S. requirements require full consultation with JAA authorities. The ARAC working group considered current international standards where they exist, and realized that restricting the upgrades to ED–55 standards would not satisfy the NTSB recommendation. The standards proposed are harmonized with the current JAR-Ops, which are based on the ED–55 standards; the additional U.S. requirements have no JAR counterpart with which to harmonize. No changes were made as a result of this comment.

Aerospace Industries Association (AIA) submits technical comments and editorial comments regarding typographical errors. For parameter 88, all cockpit flight control input forces (control wheel, control column, rudder pedal), AIA comments that the force sensor accuracy in the appendix should be changed from "+/−5%" to "+/−5% or +/−15% of actual, whichever is greater or as installed." AIA also comments that the accuracy values in the appendix for the Force Sensor Range for Wheel, Column, and Pedal ranges of parameter 88 should be changed to include the words "or as installed" after the numerical values. Also for parameter 88, AIA suggests the following language be added to the remarks column: "Force Sensor Range requirements are based on FAR 25.143(c)." Finally, AIA suggests that the Force Sensor requirements in the Accuracy column for parameter 88 should be moved from the Accuracy column to the Range column.

FAA Response: During ARAC working group meetings, NTSB representatives made it clear that the NTSB needs the full range control forces to be recorded as outlined in the NPRM with no exceptions. Force Sensor Range requirements in this rule are not based on the requirements in § 25.143(c) because slightly stricter requirements are needed to yield the desired information for accident and incident investigation.

The FAA agrees that the Force Sensor requirements for parameter 88 should be moved from the Accuracy column to the Range column in the appendices; the change is reflected in this final rule.

AIA also commented that the following should be added to the Remarks column in the appendices for parameters 82, Cockpit trim control input position—pitch, 83, Cockpit trim control input position—roll, and 84, Cockpit trim control input position—yaw: "Where mechanical means for control inputs are not available, Cockpit Display Trim Positions should be recorded." Its rationale for the change is that modern transport aircraft do not always use mechanical trim controls.

FAA Response: The FAA concurs and the language in the Remarks column in the appendices for parameters 82, 83, and 84 has been revised.

Finally, AIA comments that the language in the Remarks column in the appendices for parameter 32, Angle of attack (if measured directly), is incomplete and should be changed to read as follows: "If left and right sensors are available, each may be recorded at 4 or 1 second intervals as appropriate so as to give a data point at 2 seconds or 0.5 seconds as required."

FAA Response: The FAA concurs and the language in the Remarks column in the appendices for parameter 32 has been changed. Also, all typographical errors noted in AIA's comments have been corrected in this final rule.

its software and hardware.

FAA Response: The NTSB recommendations on which this rulemaking action is based indicate that both control input and surface position are necessary for both conventional mechanical flight controls and fly-by wire controls. Past accident investigations support the need for this data. Further, although the NTSB has used derived information in support of some findings in accident investigation, the NTSB has noted that derived information may include too many variables to support the determination of probable cause of an accident.

The FAA acknowledges that some technical constraints regarding force sensors may currently exist. The recordation of the associated parameter, however, is not required until 5 years from the effective date of the final rule, and the FAA anticipates that within the next 5 years, these technical constraints will be overcome. Also, with regard to the ability to record 256 wps, the FAA maintains that there are recorders available today that include this technology, and expects them to be more readily available within 5 years, when newly manufactured airplanes must have recorders capable of recording all 88 parameters.

The FAA acknowledges that the DFDR enhancements proposed by this rule are expensive and that a recognized safety return may not immediately be recognized. However, the FAA maintains that the information collected will aid in accident and incident investigations and will help detect trends so that corrective measures can be taken before an accident occurs, and that collection of this data is in the public interest.

The FAA notes that the additional cost information submitted by Embraer is consistent with information submitted by ARAC working group members during development of the NPRM. Further discussion of other comments concerning economic issues can be found in this preamble under the section ''Regulatory Evaluation.'' No changes were made to the proposal as a result of Embraer's comment.

Sheehan Consultants comments that the acceleration resolutions need to be upgraded in the final rule from 0.01g to 0.004g's to be consistent with the requirements in ED–55. It states that the change would have no impact on current recorders because they already meet the ED–55 requirements. The commenter states that accident investigators need very fine resolution to observe an airplane bouncing on the joints of a runway during taxi, takeoff, and landing, as well as other quick flight path changes, structural breakup, and explosions.

FAA Response: The FAA agrees that the resolution for all three acceleration parameters in parts 121, 125, and 135 should be changed to harmonize with the EUROCAE document ED–55. The final rule reflects the change in the resolution column of the appendices for parameters 5, 11, and 18 to read 0.004g's.

Aerospatiale and Alenia (ATR), manufacturers of ATR airplanes, comment that compliance with the primary flight control and master warning recording requirements would involve significant software modification and hardware modification of the flight data acquisition units (FDAU's), plus additional wiring. The two manufacturers state that the design changes would cost $100,000 per aircraft for U.S. operators for parts and labor, in addition to down time associated with completing the modifications. ATR requests that some flexibility be introduced into the requirements that would take into account certain design features such as flight control characteristics or aircraft weight. In addition, ATR states that harmonization with the EUROCAE ED–55 requirements should be considered for the retrofit requirements.

FAA Response: The FAA acknowledges that there may be alternatives to obtaining data other than direct recordation. However, the proposed sampling rates, resolution readouts, and parameter list in the NPRM represent contributions from all members of the ARAC working group. The ARAC working group made every effort to match the requirements in the proposal to both the requirements in ED–55 and the NTSB recommendations, and the FAA has determined that the differences are insignificant for U.S. operators. No changes were made as a result of this comment.

of those proposed in the NPRM. Airbus Industrie suggests that the FAA require recordation of only those parameters included in EUROCAE ED–55, and states that anything else would constitute disharmony with European regulations. The commenter does not oppose the recordation of additional data, but would like to see more international involvement to determine what additional data should be included, and suggests that the effort be addressed within the ICAO and within the FAA/JAA Harmonization Work Program under the ARAC process before additional parameters beyond ED–55 are added.

Airbus Industrie also suggests that proposed §§ 121.344 and 125.226 be revised so that current FDR's that already record the necessary parameters, but not at the specific sampling or resolution readouts listed in Appendix K (corrected to read Appendix M), not be required to incur retrofit costs simply to meet those Appendix M values. Airbus Industrie believes that the introduction of this flexibility would result in significant cost savings to industry without jeopardizing the capability of investigating events.

FAA Response: The FAA acknowledges that there may be alternatives to obtain data other than direct recordation. However, the proposed sampling rates, resolution readouts, and parameter list in the NPRM represent contributions from industry representatives, the FAA, and the NTSB. During ARAC working group meetings, the NTSB argued that information gathered from interpretation was not as reliable as direct recordations, as discussed above. Some industry representatives did not agree. After further discussion, the working group decided that, to respond to the NTSB recommendations on which this rulemaking is based, the rule would be written with a requirement for direct recordation of the parameters listed. Although Airbus Industrie presents an alternative to obtaining information directly from a flight data recorder, the FAA has determined that justification provided by Airbus Industrie is not sufficient to overcome the NTSB's arguments that information gathered from interpretation is not as reliable as direct recordation. Accordingly, there was no change to the proposal as a result of this comment.

As previously stated, the FAA disagrees that international disharmony occurs as a result of this final rule. The ARAC working group made every effort to make the proposal identical, where applicable, to the requirements of ED–55. However, the FAA has determined that those requirements alone are insufficient for U.S. operators or U.S.-registered airplanes, and in fact would not satisfy the intent of the NTSB recommendations. Accordingly, the FAA proposed the additional requirements. The FAA disagrees with the suggestion that more international involvement is needed to develop U.S. regulations that govern U.S. operators and U.S.-registered airplanes. No changes were made as a result of this comment.

Fairchild Aircraft, Inc. (Fairchild), opposes the requirement for newly manufactured 10–19 seat airplanes to record 57 parameters effective 3 years after the effective date of the rule, and 88 parameters effective 5 years after the effective date of the rule. As proposed, the rule would require that these airplanes include a flight data acquisition unit (FDAU), plus the sensory devices and associated wiring for each (additional) parameter. Fairchild states that compliance with current § 135.152 and implementation of the proposed § 121.344a(a) is more than adequate for the size and complexity of any airplane in the 10–19 seat category. It is the commenter's understanding that the goal of this rulemaking is to provide information regarding accidents and incidents as they occur, and it notes that 10–19 seat aircraft have no history of accidents of undetermined cause.

Fairchild believes that the money needed to comply with the proposed regulations could be better spent improving overall operations. It states that an FDR will not increase the level of safety in the 19-seat airplane, and will probably diminish the level of safety, because funds will be diverted to comply with something of no value versus something of positive value. Fairchild also states that, if adopted, the proposal would have a significant negative impact on the competitiveness of current operators and airplanes made in the United States that are sold on the international market. Fairchild believes the proposed changes would increase operating costs and thus negatively affect future sales in both the United States and foreign markets, particularly to customers in developing nations. Finally, Fairchild submits some cost information, as well as the following technical comments:

Fairchild recommends deletion of § 121.344a(b) and (c), which would require newly manufactured airplanes with 10 to 19 seats to install enhanced DFDR's. Fairchild also notes that in § 121.344a(a)(1)(iv),

FAA Response: As stated in the NPRM, when the NTSB made its recommendations in February 1995, the FAA has not yet issued its rule that requires most airplanes that have 10–19 seats that were formerly operated under part 135 to operate pursuant to the requirements of part 121 beginning in March 1997. Because the purpose of that rulemaking action was to establish "one level of safety," the NPRM associated with this final rule, and all rules developed from this point forward, reflect that agency policy. Recognizing the differences between larger airplanes operating under part 121 and those designed to carry 10–19 passengers, the FAA developed a special section in the NPRM to specifically address the flight data recorder requirements for these airplanes. The ARAC working group discussed and decided that the intent of the NTSB recommendations was to capture all airplanes regularly used in commercial service, including those that began operating under part 121 beginning in March 1997.

The FAA disagrees with the suggestion to delete § 121.344a(b) and (c) for newly manufactured airplanes. The suggestion is inconsistent with the NTSB recommendations, and no alternative to satisfy the recommendation was suggested. No change was made as a result of this comment.

The FAA agrees that the second reference to Appendix B in § 121.344a(a)(1)(iv) is an error; "Appendix B" should read "Appendix M." The rule has been revised accordingly.

The FAA finds that insufficient information was submitted to justify the addition of the following planes to the list of airplanes that need not comply with the requirements in § 121.344a, but continue to comply with the requirements in § 135.152: SA227–AC, SA227.TT, SA227–AT, and SA227–BC. The fact that airplanes were manufactured before October 11, 1991, is not considered sufficient to justify their exclusion. No change was made as a result of this comment.

The FAA agrees that the FH227 does not belong to Fairchild Aircraft, Inc., and the final rule has been revised to reflect the aircraft is a product of Fairchild Industries.

All typographical errors noted by the commenter have been corrected in this final rule.

Southwest Airlines (SWA) comments that the language proposed in § 121.344(b)(3) be changed to remove reference to installation no later than the next heavy maintenance check that occurs after two years after the effective date of the final rule. The commenter believes the final rule should only require compliance by the final date of the rule and should not include any milestones or restrictions. In addition, SWA comments that the sampling rates given in Appendix M have been increased from the rates initially proposed by ARAC working group members, and that the higher sampling rates may require additional modifications and expense.

FAA Response: The issue addressing the earliest possible compliance time was discussed in the preamble to the NPRM. In that document, the FAA stated that "heavy maintenance check" provision was added to prevent operators from waiting until the last minute to install upgrades, causing a logjam in scheduling and equipment availability. The proposed sampling rates reflect those needed by the NTSB to aid in accident and incident investigations. No changes were made as a result of this comment.

Airborne Express comments that lateral acceleration cannot be recorded at the specified recording intervals using the Loral F800 flight data recorder. Airborne Express states that 70% of its fleet is fitted with the Loral F800, and to replace these recorders would constitute an undue burden. The commenter suggests that language be changed to reflect that, except for the Boeing 737, lateral acceleration should not be required to be recorded unless sufficient capacity is available on the existing recorder to record that parameter and that the recording ranges, accuracies, and recording intervals be limited to those specified in current Appendix B to part 121. In addition, Airborne Express asks for clarification of the term "capacity" as it is used in proposed § 121.344(b)(1)(i) so it can determine whether it can comply with the proposed rule language.

FAA Response: According to Loral, the manufacturer of the F800 recorder, lateral acceleration can be recorded for the Airborne Express installation if a nonrequired parameter is removed from the input to the recorder, and the existing spare channels are used. The term "capacity" refers to the design of a recorder to be able to record a certain number of parameters and store them for 25 hours. For

data is adequate for accident prevention and investigation, and that the proposed requirement will result in a costly retrofit for the purpose of a data-gathering exercise that is not justified by any benefit/cost comparison. Piedmont believes it would be cost beneficial to require recording up to 17 parameters but it disagrees that, other than for powered flight controls, both the control surface and the input need be recorded.

FAA Response: The FAA realizes that this rulemaking action may appear to be intended for certain airplanes that have been involved in accidents, the cause of which has not been determined. As stated in the NPRM, the FAA has determined that since the cause of these accidents is unknown, it is possible that similar incidents may occur on other airplane types. Therefore, the FAA finds that the need to record additional flight data is applicable to all airplanes covered by the final rule. The FAA recognizes that DFDR's do not in and of themselves prevent accidents; they are used as an investigative tool when accidents or incidents occur. However, the FAA does not agree that continuing the current level of data collection is acceptable for future accident investigation. The FAA recognized in the NPRM that additional flight data can be collected cost-effectively, particularly in light of the NTSB recommendations. No changes were made as a result of these comments.

Twin Otter International, Ltd. (TOIL) and its affiliate by ownership, Grand Canyon Airlines, Inc. (GCA) comments that its members use deHavilland DHC–6–300 airplanes in their operations. This airplane type went out of production before October 11, 1991. TOIL claims that the DHC–6–300 was not designed to accommodate flight data recorders, and that installation would require extensive redesign and would be prohibitively expensive. In addition, the manufacturer is not interested in participating in the cost of certifying and retrofitting the airplanes for flight data recorder installation and no other airworthiness authority worldwide requires a DFDR in the DHC–6–300. TOIL states that no DHC–6–300 has ever been equipped with a DFDR.

The commenter states that the reversal of the policy determination addressed in Notice 96–7 would create a regulatory inconsistency because 12 of its DHC–6–300 airplanes would be required to be retrofitted, while 26 others owned by the companies would not. It states that the same airplane type brought onto the register after October 11, 1991, is no less safe than one brought on before that date, and recommends that in lieu of reversing the policy determination, the FAA should revise proposed § 121.344a to read "manufactured after October 11, 1991," in lieu of "brought onto the U.S. register after . . ." that date. Further, the commenter points out, airplanes of foreign registration (not required to comply with U.S. DFDR requirements) may be allowed to be operated in the United States by a U.S. air carrier without being on the register, and would have an economic advantage over U.S.-registered airplanes.

FAA Response: Twin Otter International, Ltd. presented significant evidence why the DHC–6 airplane (Twin Otter) should be exempted from the flight data recorder upgrade requirements proposed in the NPRM, and the final rule includes an exemption for the DHC–6, whether the airplanes are operated under part 121 or part 135.

The FAA fully considered the popularity of this aircraft model in the sightseeing industry, and determined that the exemption is still appropriate. The FAA does not agree with TOIL's characterization of the effect of the policy change announced in Notice 96–7, nor that the policy announced in Flight Standards Information Bulletin 92–09 should be codified. The revised policy states that airplanes previously registered in the United States that were removed and brought back on the register after October 11, 1991 are not "grandfathered" and must install flight data recorders. This interpretation is consistent with both the language and the intent of the current rule. While the FAA acknowledges that the October 11, 1991 date creates two classes of airplanes that are otherwise the same, any other method of distinguishing airplanes that must be retrofitted would have an equally bifurcated effect. TOIL's proposed solution to use October 11, 1991 as a date of *manufacture* to distinguish those airplanes to be retrofitted is a solution only for aircraft out of production; airplanes in production would continue to be separated into two classes by the date regardless of how identical two airplanes were when they came off the production line. The 1991 "brought on the U.S. register" date was adopted in 1988, and a well-defined class of airplanes was established. The FAA has no reason to now disrupt the applicability of the flight

was adopted to minimize costs and to deter the importation of older, non-DFDR equipped airplanes. The fact that the language created a separate standard for non-U.S. registered airplanes was unintentional; the FAA always intended to cover all of the airplanes operating domestically. TOIL did not comment on the change proposed in the SNPRM. Based on the comment of TOIL, the final rule language includes an exemption for the Twin Otter. No other changes were made based on this comment.

The Regional Airlines Association (RAA) comments that it supports the enhancement of FDR recording parameters where the benefits can be shown to justify the costs, and suggests that the compliance period be extended to 6 years. RAA supports the proposed rule as it applies to newly manufactured aircraft. However, RAA states that many of the proposed requirements to retrofit new recording parameters into existing airplanes have not been shown to provide a direct safety improvement or to be cost effective, and that requiring installation will impose a severe economic burden on affected operators, resulting in increased costs of travel to the public, and thus should be eliminated.

FAA Response: The FAA recognizes that the DFDR enhancements proposed by this rule may be costly and may not provide immediately recognized benefits. However, cost alone cannot justify ignoring the potential safety gain represented by the improvements required by this rule. The FAA has determined that this final rule should be promulgated as in the public interest, and RAA has not submitted sufficient justification to show that it is not in the public interest. No changes were made as a result of this comment.

The Air Line Pilots Association (ALPA) agrees with the proposal except for the proposed compliance period, and suggests that the FAA contact FDR and FDAU manufacturers directly to validate the economic information supplied in the NPRM. The commenter believes that the four year compliance period outlined in the proposed rule for the retrofit of FDR's is too long, and that three years is more appropriate.

FAA Response: The FAA relied heavily on the industry members of the ARAC working group to supply accurate economic information, including costs of parts, labor, and aircraft down time. The information was provided in aggregate form based on major cost components, not in detail. Therefore, contacting the manufacturers of specific parts such as the FDR's and FDAU's would not yield useful additional economic information. During development of the proposal, the ARAC working group discussed extensively the most appropriate compliance period—one that would be practical both technologically and economically. Manufacturers and operators argued that four years is necessary to redesign any affected areas, and to incorporate any needed retrofits into a regular maintenance schedule in order to minimize the down time required for installation of DFDR enhancements. The FAA also notes that the required upgrades may be accomplished sooner than the prescribed four years; the final rule requires the installation of the DFDR no later than the next heavy maintenance check, or equivalent, after two years after the effective date of the final rule. No changes were made as a result of this comment.

General Aviation Manufacturers Association (GAMA) comments that the FAA has gone beyond the scope of the NTSB recommendations by including 10 to 19 passenger airplanes in the NPRM. GAMA also states that it considers the requirements proposed not to be cost beneficial, and thus a final rule should not be published. GAMA indicates that requiring enhanced DFDR's would not support the theory of eventual zero unexplained accidents per year simply by increasing the number of parameters being monitored. The commenter states that a regulatory analysis is not provided for newly manufactured airplanes and feels this is necessary by law and is essential. GAMA also disagrees with the FAA's conclusion that the cost of developing a 256 word per second recorder is insignificant. It cites the requirement to develop standards through committees, and the issue of possible import design and data correlation as additional cost burdens. GAMA comments that the FAA highlights the benefits of the NPRM and downplays costs, and that the proposal does not adequately quantify the benefits. The FAA should be required to conduct a full and complete cost analysis of the total NPRM impact prior to issuing a final rule. GAMA further maintains that although the FAA states that no disharmony is created in the proposal, it disagrees, and lists areas of possible conflict as parameters 40, 41, 42, and 44.

GAMA also comments that the NPRM should include rule language that would exclude retrofit requirements for existing airplanes operated under part 135 for on-demand service, and would exclude

For newly manufactured airplanes, GAMA believes there are differences between parameters that some operators have chosen to record and proposed parameters 58–88. GAMA asks whether operators must cease recording parameters of choice or those required in the JAR-Ops and/or ED–55, and instead record the proposed extended parameters. GAMA believes clarification is needed regarding these issues.

FAA Response: As explained in the NPRM, when the NTSB made its recommendations in February 1995, the FAA had not yet issued its rule that requires most airplanes that have 10–19 seats that formerly operated under part 135 to comply with the requirements of part 121 beginning in March 1997. Because the purpose of that rulemaking action was to establish ''one level of safety,'' the NPRM associated with this final rule, and all rules developed from this point forward, reflect that agency policy. Recognizing the differences between larger airplanes operating under part 121 and those designed to carry 10–19 passengers, the FAA developed a special section in the NPRM to specifically address the flight data recorder requirements for these airplanes. The ARAC working group discussed and decided that the intent of the NTSB recommendations was to capture all airplanes regularly used in commercial service, including those 10–19 seat airplanes that began operating under part 121 in March 1997.

The FAA recognizes that increasing the number of recorded parameters may not realize an immediate safety return, but maintains that the information collected will aid in accident and incident investigations, and will help detect trends so corrective measures can be taken before an accident occurs. The FAA also maintains that as more information is recorded, the occurrence of unexplained accidents and incidents will decrease.

Regarding the commenters statements addressing the cost/benefit analysis, an analysis for newly manufactured airplanes, costs associated with developing a 256 word per second recorder, and other cost burdens: these and other comments concerning economic impact are discussed further in the Regulatory Evaluation section of this preamble.

The FAA disagrees that disharmony is created in the proposal, and notes that harmonization does not mean identicality. The final rule is as similar as practicable with international standards, where they exist, and goes beyond international standards only to accommodate the NTSB recommendation, which is the original basis for this rulemaking action.

The FAA disagrees that the proposed rule language should be changed to exclude retrofit requirements for existing airplanes operated under part 135 for on-demand service. As proposed, the rule is not applicable to these airplanes. Only those part 135 airplanes that operate scheduled, commuter operations that have transferred to part 121 as of March 1997 will be subject to retrofit requirements in this rule. The FAA also disagrees that the proposed rule language should be changed to exclude newly manufactured airplanes that will be operated in on-demand service. For reasons stated in the preamble to the NPRM, the FAA finds that all airplanes affected should comply with the new regulations, regardless of the nature of their operation. The FAA disagrees with the commenter's suggestion that language be added to exclude airplanes certificated for nine or fewer passenger seats and all rotorcraft. Section 135.152 does not apply to airplanes with nine or fewer passenger seats, and the proposed language in § 135.152(f) applies only to airplanes that would be required to be equipped in accordance with §§ 135.152(a) or (b), as appropriate.

With respect to the commenter that some of the parameter name and corresponding remarks are ambiguous, the FAA notes that the names and remarks have evolved over time and are generally accepted by industry. The names and remarks were discussed during the ARAC working group meetings in which GAMA participated. No technical concerns over the names of the parameters were raised by the commenter at the time or subsequently by any other commenter. The nature of the commenter's questions concerning specific parameter names will be considered in preparation of the Advisory Circular already under development.

The FAA disagrees that the text contained in the appendix ''Remarks'' column should be incorporated into the rule language for flight control breakaway capability parameter. The FAA has determined that

but must record the required parameters. The FAA acknowledges that some operators may have to change the parameters currently being recorded, unless an operator chooses to replace its equipment for that with greater capacity.

The National Air Transportation Association (NATA) comments that proposed § 135.152 should be revised in the final rule to differentiate the applicability of the new requirements by "kind of operation" in which a 10 to 30 seat airplane is used. It also comments that the final rule language should be clarified concerning its applicability to 10 to 30 seat airplanes used in part 135 on-demand operations. The FAA is unable to understand clearly NATA's comment regarding proposed regulations for airplanes brought onto the U.S. register on or before October 11, 1991. The FAA concludes that NATA is suggesting that affected commuter airplanes operated under § 121.344a that are brought onto the U.S. register after October 11, 1991, should be required to meet only existing part 135 requirements. NATA appears to believe that there is no justification in requiring two sets of regulations for the same airplane type simply because of registration date, and suggests that the October 11, 1991, date be deleted and that the date of manufacture be used instead. NATA agrees with the exclusion of rotorcraft and airplanes certificated with nine or fewer passenger seats from the regulations, but feels that the term "multiengine," which is included in current § 135.152(a) and (b), should be included in proposed §§ 135.152(i) and (j).

FAA Response: The FAA appreciates the NATA comment but it does not agree that applicability is an issue for this final rule. The FAA recently promulgated new part 119, which determines the type of operation that is applicable to an on-demand or commuter operation. When using the definitions of part 119, it is clear that § 135.152 applies to on-demand operators of the 10–30 seat airplanes, and that § 121.344a applies to scheduled commuter operators. The FAA acknowledges that DFDR's do not in and of themselves prevent accidents; they are used as an investigative tool when accidents or incidents occur. However, it does not agree that continuing to obtain the current level of information required to be recorded by § 135.152 without obtaining any new information is acceptable for future accident investigation. Similarly, the FAA does not agree with NATA that the term "multiengine" should be included in the new §§ 135.152(i) and (j) for certain newly manufactured airplanes. In its deliberations, the FAA decided that a new, single-engine, turbine-powered airplane capable of carrying 10 to 30 passengers should meet the same standard as the multiengine airplane carrying the same number of passengers. Since NATA has not submitted any additional justification that would warrant different treatment of these airplanes, no changes were made as a result of this comment.

The Air Transport Association (ATA) generally supports the proposed rule, but expresses disagreement in the following areas. ATA comments that because the FAA proposes more parameters than are included in the JAR-Ops, harmonization is not achieved, and suggests that the FAA should restrict its list of parameters to those required by European standards, even if it means keeping the number of newly manufactured airplane DFDR parameters at 57. ATA also comments that increasing sampling rates in newer generation aircraft is not cost effective and recommends that several parameters be recorded at a sampling rate of once per second rather than twice per second as proposed. (The specific parameters will be addressed in the FAA reply.) In addition, ATA requests clarification regarding those aircraft that fall under the requirements of Appendix B and have the flight control breakaway capability that allows either pilot to operate the controls independently.

ATA comments that the Lockheed Aircraft Corporation Electra L–188 should be included on the list of airplanes that would not have to comply with the new proposal. The L–188 is out of production but remains in service. ATA also comments that the Loral 800 FDR does not have the capacity to record lateral acceleration at the rate of 4 words per second, as proposed. A two-engine airplane equipped with the Loral F800 is only capable of recording this parameter at a rate of 1 wps. ATA recommends that Appendix B be revised to allow a recording rate of 1 wps for lateral acceleration for airplanes equipped with 32 wps recorders.

Also, ATA comments that the NPRM does not take into account aircraft with specialized data acquisition systems that may be capable, for example, of recording primary axis controls, either by pilot inputs or by surface position, but is not capable of recording both. ATA maintains that software to support

add the new parameters (numbers) to the original list, their maintenance manuals, and word cards.

ATA states that the FAA's time frame for compliance is more reasonable than that proposed in the NTSB recommendations, but still maintains there will be a tremendous burden on manufacturers, operators, and suppliers, as well as the FAA. Although FAA rejected ATA's earlier recommendation to establish a phased compliance schedule, ATA now suggests the FAA should survey operators annually after the effective date of the rule to determine the status of operator retrofit programs.

ATA states that with a few exceptions, its cost estimates generally agree with the data presented by the FAA in the proposed rule. It states, however, that some costs were not addressed in the NPRM, and consequently, ATA feels the FAA's cost estimates underestimate the total program costs.

FAA Response: The FAA disagrees that disharmony occurs as a result of this final rule. The ARAC working group made every effort to make the proposal identical, where applicable, to the requirements of ED–55. However, the FAA has determined that those requirements are insufficient to satisfy NTSB recommendations for U.S. operators, and has thus provided some additional requirements. The FAA recognizes that there may be other alternatives to obtain data, but no comprehensive alternative that would meet the NTSB recommendations has been presented, nor cost data submitted for comparison. The proposed sampling rates, resolution readouts, and parameter list in the NPRM were developed with input from industry representatives, the FAA, and the NTSB. The FAA has determined that justification provided by ATA is not sufficient to change the proposal.

The FAA agrees that the Lockheed Aircraft Corporation Electra L–188 should be included in the list of airplanes that need not comply with these amendments, and the applicable sections have been revised in the final rule.

The FAA does not agree that the Loral F800 is incapable of recording 4 samples per second (the FAA assumes ATA misquoted the NPRM when it said 4 words per second), as proposed. According to the manufacturer of the F800 recorder, lateral acceleration can be recorded at 4 samples per second if a nonrequired parameter is removed from the input to the recorder, and the existing spare channels are used.

Regarding specialized equipment configurations, the FAA requested for specific comment from TWA and other operators that may find themselves in unique circumstances. Although the ATA comment points out a unique problem with specialized FDAU's, the limitations are of recording system capacity caused by out-of-date software. The FAA is not inclined to revise the proposed rule in such a way to encourage the continued use of old, insufficient software. The FAA does acknowledge that extenuating circumstances may occur, and so may consider exemptions requesting relief from the recordation of specific parameters if an operator can show that all efforts to rearrange nonrequired parameters and software "fix" solutions have been exhausted, and that the only solution would be an expensive equipment upgrade.

The FAA acknowledges that some of the accuracies listed are not the same as those listed by the manufacturers, but maintains that to achieve the minimum level of safety prescribed by the rule, and to maintain the continuity of recorded data, the FAA must establish the standards, not the individual manufacturers.

The comment concerning operator maintenance programs is not a flight data recorder issue, and is beyond the scope of this rulemaking action. The current rule does not prohibit, and the NPRM did not propose to prohibit those operators with a parameter-number-based FDR maintenance program from adding new parameters (by number) to the original list, their maintenance manuals, or word cards.

Regarding the commenter's suggestion to survey operators annually after the effective date of the rule to determine the status of operator retrofit programs, the FAA finds that the exercise would serve no useful purpose and would require additional resources and paperwork. Operators may submit their DFDR retrofit status at any time on a voluntary basis. During working group discussions, it was decided that a phased-in compliance schedule would not be necessary because affected airplanes could be retrofitted

suggests a December 1997 compliance date for retrofit of these airplanes.

In addition, for newly manufactured airplanes, the NTSB comments that most of the 88 parameters included in the FAA's proposal are currently being recorded, or are capable of being recorded with little cost, by existing FDR systems. Therefore, the NTSB believes that there does not appear to be a justifiable technical or economic reason for not requiring a full 88-parameter installation on newly manufactured aircraft by 3 years after the date of the final rule.

The NTSB also comments that the parameter ''Overspeed Warning'' should be added to the parameter list for newly manufactured airplanes, and that the final rule should explain in greater detail the significance of the Appendices Header, which reads ''The recorded values must meet the designated range, resolution and accuracy requirements during dynamic and static conditions. All data recorded must correlate in time to within one second.'' The NPRM does not make it clear that this statement may have a significant impact on some existing airplanes with FDR parameters that do not reflect the actual condition of the aircraft during certain dynamic conditions. Certain data may not be recorded accurately due to filtering that takes place prior to recording.

The NTSB would like the FAA to change the proposed language to require non-FDAU equipped aircraft to be equipped with FDAU's and believes that the benefit would justify the additional $50,000 per aircraft cost of this retrofit. Adding a FDAU enables the recording of all the FDR parameters recommended by the Board in Recommendation 95–26. It would also provide reserve capacity for future FDR parameter needs that may become necessary in the future as a result of accident investigations and/or technology advancements.

In addition to the 1997 compliance date for Boeing 737 retrofits and the 3-year compliance date for newly manufactured airplanes, the NTSB suggests that industry should be able to retrofit the affected existing fleet within 2 years from the issuance of the final rule, rather than the 4 years proposed in Notice 96–7.

FAA Response: The FAA has fully explored with ARAC the NTSB recommendations concerning the Boeing 737 and a 2-year versus 4-year compliance date. During the course of the ARAC working group deliberations, the aircraft manufacturers presented and justified arguments that they would need more than 3 years to incorporate the engineering designs necessary to accommodate the proposed parameters that are beyond those listed in ED–55. The FAA published the result of those deliberations in the NPRM, which provided the rationale for these proposals and the retrofit of the existing fleet. The aviation industry provided information that indicated a 2-year retrofit schedule would be prohibitively costly, and that it may be technologically impossible to complete a fleet retrofit in less than 4 years. In addition, a mandatory 2-year retrofit schedule would have had a major effect on the traveling public due to unscheduled groundings of airplanes that would be necessary to meet the requirement. During ARAC discussions, industry and the FAA found that a 2-year retrofit would be burdensome, and discussed whether a faster retrofit would result in expenditures that would undermine separate attempts to find the cause of incidents and accidents. Finally, the FAA determined that a 4-year compliance time would permit the operators to schedule DFDR retrofits during a major maintenance check, e.g., a ''D'' check, while the aircraft is at a maintenance facility that has the equipment and technical capability to perform the installation and the modifications to the airframe. The NTSB has presented no new persuasive arguments that would justify changing the proposal.

Since the Pittsburgh (Aliquippa) Boeing 737 accident, Boeing has concentrated its efforts on using the available actual data and derived data to better understand the possible causes of this accident. Boeing has recently introduced changes in the Boeing 737 rudder system that it believes will prevent future rudder-induced rollover accidents. The FAA acknowledges the merits of the Boeing program and notes that such activities could be cut short if time and resources had to be directed toward meeting an accelerated DFDR retrofit schedule. At best, the recording of additional parameters may highlight where a problem exists. The rudder redesign efforts of Boeing, however, are a positive action that might prevent future accidents, and care must be taken not to inhibit such actions unnecessarily.

industry for the parameters already proposed. The FAA will consider adding the parameter in future rulemaking.

The NTSB requests a more detailed explanation of the Appendices Header that, as proposed, reads: "The recorded values must meet the designated range, resolution and accuracy requirements during dynamic and static conditions. All data recorded must correlate in time to within one second:." The FAA added the requirement for a *dynamic* test condition to ensure accurate dynamic recording of aircraft performance. This requirement was necessary to preclude the presumption that information that may be obtained from filtered or modified signals. Correlation must be within one second between recorded data and actual performance. The FAA agrees that further explanation of these tests is needed, and intends to address the test procedures in an upcoming Advisory Circular to clarify the recording of dynamic and static conditions, and other acceptable means of compliance with the rule.

The original NTSB recommendations did not fully recognize the considerable constraints of DFDR retrofit of older airplanes that are out of production and are not equipped with flight data acquisition units (FDAU's), and for transport category airplanes whose type certificates apply to airplanes still in production. The NTSB did not recommend that 88-parameter recorders be installed in those airplanes. The ARAC team discussed the differences between FDAU-equipped and non-FDAU-equipped airplanes and recognized that the NTSB recommendation could not be fully accommodated without a FDAU retrofit of older airplanes. However, the costs related to redesign and retrofit were found to be excessive when compared to the benefits gained in older, less complex airplanes. Therefore, the ARAC team recommended different retrofit requirements for three different categories of airplanes, depending on their age and equipment already installed. Those categories and requirements were discussed in Notice No. 96–7, and are summarized in a chart printed in this preamble. The FAA has fully debated this issue and disagrees with the NTSB comment concerning FDAU retrofit of older airplanes, including that an additional $50,000 cost per older aircraft is justified. The FAA finds that the NTSB has submitted no new information that either was not considered by the FAA or that would justify developing a supplemental notice to incorporate this comment. No changes have been made as a result of the NTSB comment.

Several members on staff at the West Virginia University (WVU) comment that a virtual flight data recorder that they have been developing is capable of achieving the same result that an actual flight data recorder can, at much lower costs to industry. Congressman Nick J. Rahall II and Senator John D. Rockefeller IV, both of West Virginia, and the Air Transport Association (ATA) submitted comments in support of the WVU comment. The ATA states that the FAA and the NTSB should fund this technology.

FAA Response: The information presented in this comment is beyond the scope of this rulemaking action. It is ultimately the responsibility of the NTSB to determine whether this technology would be a useful accident investigation tool and provide the necessary funding for future research. The commenter's suggested methods of obtaining information from "virtual" flight data recorders in lieu of the proposed expanded flight data recorders, while interesting, would not satisfy the NTSB recommendations being addressed in this final rule, especially considering the NTSB's expressed need for directly recorded data. No change was made as a result of this comment.

An individual comments that the FAA does not provide a cost benefit analysis in the NPRM. In addition, the commenter believes the proposed rule is unnecessary and will not automatically improve aviation safety. He presents a number of hypothetical probable causes for accidents discussed in the preamble of the NPRM and suggests that improved inspection, maintenance, and training would better serve to prevent similar accidents. The commenter also states that it is necessary to record both pilots' inputs (force and displacement) as well as the control surface positions.

FAA Response: The NPRM contains a summary of a cost-benefit comparison. A more complete analysis is contained in the docket. The FAA disagrees that the proposed rule is unnecessary, although the immediate safety benefits may not be readily apparent. Currently, DFDR's are being used to aid accident investigation. Furthermore, the FAA is convinced that the enhanced data collection required by this rule will improve the accuracy and completeness of accident and incident investigations through

Regarding the comment on the requirement for recording from the pilot and the copilot both force and displacement, the FAA maintains that the rule provides for the recording of both pilots' inputs. For clarification, the information in the "Remarks" column has been revised in the final rule.

An individual comments that he would like to see another item added to the NPRM in light of the recent crashes of ValuJet and TWA. Specifically, he suggests that the rule require an independent, lightweight, stand-by power supply to the CVR and FDR in the event of main bus power failure. He believes that power source should be available for 5 to 10 minutes. He believes that the NTSB agrees with his comment and asks for consideration in future rules if this comment cannot be included in this rulemaking.

FAA Response: The commenter did not present enough information to support the idea that a stand-by power supply would be useful during a catastrophic failure in which the recording sensors are disabled or destroyed. Since power sources for flight data recorder equipment were not part of the notice, the comment is beyond the scope of the rule, and no changes were made as a result of this comment.

Discussion of Comments to Proposals for Part 129

Airbus Industrie comments that it believes the most recent international standards, as established by ICAO, should be sufficient to meet the intent of the NTSB recommendations, and believes that to require additional standards for non-U.S. operators would impose heavy retrofit costs. The commenter believes that most parameters proposed can, with currently installed equipment, be either recorded directly or reliably determined from other data, and requests that more flexibility be allowed to derive certain parameters from other data as an alternative to direct recording.

FAA Response: The ARAC working group made every effort to make the proposal identical, where applicable, to the requirements of ED–55. However, the FAA has determined that those requirements alone are insufficient to satisfy the NTSB recommendations for U.S.-registered airplanes. Also, the FAA recognizes that there may be alternative methods available to obtain information, other than direct recording, but has determined that direct recordation is the most reliable method, and the best one to accomplish the needs of the NTSB. The NTSB has investigated a number of proposals wherein the proposed parameters were derived; however, the NTSB was not convinced that the methodology demonstrated was as accurate as direct recordation. No changes were made as a result of this comment.

Lufthansa German Airlines comments that a four-year compliance time is not sufficient to modify its fleet and maintains that, at a minimum, six years would be needed.

FAA Response: The commenter did not indicate the size of its fleet that would be subject to the retrofit requirements; however, the FAA would like to point out that the part 129 requirements apply only to U.S.-registered airplanes, not to the commenter's entire fleet. The FAA maintains that extending the compliance time would not significantly reduce the cost or down time involved per airplane. Since the commenter provided no further information regarding maintenance schedules or why the commenter could not meet a 4-year compliance date, no changes were made as a result of this comment.

Japan Airlines Company, Ltd. (JAL) comments that its Aircraft Integrated Monitoring System (AIMS) FDAU is almost fully occupied by parameters that JAL uses for monitoring on-board and ground-based operations. JAL maintains that requiring the recordation of additional parameters or increasing sampling rates would require modifications (including reviewing and rearranging all of the word slot assignments in its FDAU's) that would cost several million dollars and would require several months to accomplish. JAL requests that the FAA exempt from the final rule those airlines that are currently operating with AIMS, or to exempt those airlines from the proposed increased sampling rates for DFDR parameters.

FAA Response: As stated previously, the FAA acknowledges that some operators may have to change their preferred programming to accommodate recordation of the required parameters. The categories of aircraft retrofit created by this rule were chosen carefully to account for the majority of aircraft of a certain age and equipment installations. The requirements were set so as to not require overall equipment replacement for minimal gains. Accordingly, the FAA cannot exempt any aircraft simply because it is

justification that is necessary to change the proposed regulations, they are adopted as proposed.

Discussion of Comments to the SNPRM

Two commenters stated that they support the proposals in the SNPRM.

TOIL submitted further comment to justify exemption of the DHC–6–300 from the DFDR retrofit requirements. The commenter's main concern is with "the proposed reversal of policy established by Flight Standards Information Bulletin 92–09" and again urges the FAA to adopt its previous policy interpretation regarding airplanes brought onto the register after October 11, 1991, and to codify that previous policy. TOIL did not offer comments on the proposals in the SNPRM.

FAA Response: The commenter seems to have misunderstood that the change in policy announced in the NPRM was a "proposed" reversal of policy. The change in policy was a determination already made; the NPRM was merely a conduit for announcing the change since the subject matter was relevant to the NPRM and the affected parties would be notified more efficiently using that document. As stated in the NPRM and the SNPRM, the previous policy interpretation was found to be inconsistent with the text of the rule. The FAA cannot, in good faith, allow operators to continue to operate without complying with the rule and has made no changes to the rule addressing the change of policy. Further explanation is provided in this preamble in the section, "Discussion of Policy Change" below.

One individual commented that the rule should address alternate methods of powering recording devices, stating that sometimes the busses powering the recorders are turned off for isolation purposes in the event of an emergency that involves fire or smoke.

FAA Response: The FAA acknowledges the merit of this comment; however, the issue it addresses is outside the scope of this rulemaking; it may be considered in a future rulemaking action. No changes were made as a result of this comment.

RAA comments that neither the NPRM nor the SNPRM have provided data to suggest that adoption of the proposals will result in a reduction of accidents, and therefore the final rule should not be applicable for aircraft where it is shown that disproportionate economic hardship would result. The commenter feels that aircraft with 10 to 19 passenger seats should be affected only if they are newly manufactured after October 11, 1991 (as opposed to being brought onto the U.S. register, as the rule currently states). RAA comments that if the FAA does insist on adopting the rule as proposed, the 2 year compliance time stated in the SNPRM should be revised to 4 years, stating that it doesn't make sense to propose a 2 year compliance time for some airplanes and 4 years for others.

FAA Response: The FAA acknowledges that immediate benefits from this rule may not be readily recognized in terms of reducing accidents, and that DFDR's themselves can prevent accidents. However, to respond to the NTSB recommendations to provide better investigative tools for accidents and incidents, the FAA undertook this rulemaking action. Aviation industry representatives supplied the FAA with figures for the economic evaluation that was presented in the NPRM. The cost figures that the RAA submits in this comment refer only to the DHC–6–300, an airplane with a unique combination of cost factors. The FAA has determined that the DHC–6 will not have to comply with the DFDR requirements. Other operators that can justify why their airplanes should also be exempt, discussing the criteria outlined in the preamble of the NPRM and the SNPRM, may petition to have their airplanes added to the exemption paragraph in part 135.

The FAA agrees that the 2-year compliance time for airplanes of operators that "thought their aircraft were grandfathered to meet the current requirements of part 135, not for installation of an upgrade" should be revised to read 4 years, and those affected airplanes will have 4 years to come into compliance. The compliance time language that was included in the SNPRM has been removed to avoid any confusion in compliance times. Affected operators have four years to comply, whether operating under part 135 or part 121. Further explanation is provided in this preamble in the section, "Discussion of Policy Change" below.

of § 135.152 apply to aircraft registered outside the United States but placed on the U.S. operations specifications of an operator, is included in the final rule. In its comment, the NTSB indicates that specific language should also be added to part 121 requirements to ensure that all aircraft operated in part 121 service, including those under foreign registration, are operated in accordance with the flight data recorder requirements of that part. The NTSB indicates that § 121.153 would permit the use of foreign-registered aircraft that record only 5 parameters of flight data. The FAA disagrees with the NTSB's reading of § 121.153. Paragraph (c)(2) of that section requires that foreign-registered aircraft operated under part 121 must meet all of the requirements "of this chapter (14 CFR Chapter 1)," which includes all of the part 121 requirements. Thus, any foreign-registered airplane operated under part 121 must meet the FDR requirements as though the aircraft were registered in the United States.

However, after further consideration, the FAA has decided that § 121.344a should contain the same language as § 135.152 concerning aircraft placed on the operations specifications of an operator. The "brought on the U.S. register" language of § 135.152 was repeated in new § 121.344a(a), and the correction proposed for § 135.152(a) in the SNPRM also applies to § 121.344a(a). The language is included in the final rule for clarity and parallelism between the two sections. The FAA does not want to cause confusion in the applicability of § 121.344a for airplanes that are subject to it beginning in March 1997.

The FAA agrees that the simple fact that airplanes are out of production is not sufficient justification for their exclusion from the DFDR requirements. The number of out of production airplanes still operating is significant, and many airplanes have too much economic life remaining to allow them to operate with no or limited flight data recorders. The FAA disagrees that any exception to this rule be handled as exemptions on a case-by-case basis. The FAA does not grant blanket permanent exemptions, and use of that process would necessitate the reapplication of affected parties every two years. The FAA does not anticipate that circumstances would change so as to justify later the retrofit of the airplanes listed in this final rule as exempt. Further, because these exceptions are listed for aircraft types, it is more efficient to list them as part of the rule rather than having individual operators apply on behalf of themselves and all affected operators of a certain airplane type design.

Discussion of Policy Change

In the preamble to Notice No. 96–7, the FAA announced a change in policy regarding certain airplanes that were brought on the U.S. register after October 11, 1991 (61 FR 37154, July 16, 1996). The language of current § 135.152 is clear that any aircraft subject to that section that was brought onto the U.S. register after that date would have to meet the flight data recorder requirements of that section. As explained in that Notice, there has been at least one previous policy determination that certain airplanes—those that were on the register before October 11, 1991, were taken off, and were added to the register again after October 11, 1991—do not have to meet the DFDR requirements because of their previous registration. As noted, this policy is inconsistent with the clear language of the rule, and with the recently adopted rules making part 135 scheduled commuter airplanes subject to part 121 beginning in March 1997.

Comments to the NPRM and SNPRM, and telephone inquiries by operators, indicate to the FAA that some commenters thought that this was a *proposed* policy change. Commenters also took the opportunity to suggest alternative policies to cover these airplanes, including a change in § 135.152 to make it applicable only to airplanes manufactured after October 11, 1991. (See response at discussion of TOIL's comments, above.) Further, the NPRM did not contain any proposed compliance time for aircraft affected by the policy change, nor did it specifically indicate that the policy change affects all aircraft—airplanes and rotorcraft—subject to § 135.152.

In the SNPRM, the FAA proposed to give operators that had been operating under the old policy two years to comply with the regulation. The commenters note, however, that this places a burden on some operators, and could cause operators of certain airplanes that are now subject to part 121 requirements to possibly undergo a second retrofit—first to meet § 135.152 because of the policy change and again to meet § 121.344a.

Changes Adopted in the Final Rule

As a result of comments to the NPRM, the following changes were made:

(1) The Lockhead Aircraft Corporation Electra L–188 airplane was added to the list of airplanes that need not comply with proposed §§ 121.344 and 125.226, but must continue to comply with §§ 121.343 or 125.225, whichever is appropriate;

(2) The reference to Fairchild Aircraft, Inc. FH 227 was corrected to reflect the manufacturer of the FH 227 is Fairchild Industries;

(3) In all appendices, the following comment was added to the Remarks column for Parameter #88: For airplanes that have a flight control break away capability that allows either pilot to operate the controls independently, record both control force inputs. The control force inputs may be samples alternately once per 2 seconds to produce the sampling interval of 1;

(4) Technical changes to the appendices, including sampling rates; and

(5) Typographical errors were corrected and minor editorial changes were incorporated.

As a result of the SNPRM and comments to the SNPRM, the following changes were made:

(1) Proposed § 121.344a(a) and comment § 135.152(a) were revised to include turbine-engine-powered airplanes having a passenger seating configuration, excluding any required crewmember seat, of 10 to 19 seats, that were brought onto the U.S. register after, *or* that were registered outside the United States and added to the operator's U.S. operation specifications after, October 11, 1991;

(2) Section 135.152(k) was added to state that the deHavilland DHC–6 (The Twin Otter) airplane need not comply with DFDR rules. Parts 121 and 125 already included exception paragraphs; the DHC–6 was the only part 135 airplane for which justification was shown to grant noncompliance;

(3) References in part 135 to 8 hours of recorded aircraft operation were revised to read 25 hours, which reflects the current industry standard; and

(4) The rule language proposed in the SNPRM to allow a 2 year compliance time for airplanes currently not in compliance was not adopted in the final rule. These aircraft were operating without DFDR's based on a previous policy interpretation, the reversal of which was announced in the preamble of the NPRM. The policy interpretation was changed to be consistent with the current rule language, and no change in the rule language is necessary.

(5) Each of the exemption paragraphs has been revised to indicate that the exemption applies only to aircraft manufactured before the effective date of this final rule.

FLIGHT DATA RECORDER UPGRADE REQUIREMENTS

Category 1 No FDAU*, mfd on or before 10/11/91	Category 2 FDAU, mfd on or before 10/11/91	Category 3 FDAU, mfd after 10/11/91	Category 4 FDAU, mfd 3 (or 5) years after final rule
CURRENT PARAMETERS			
11 parameters	17 parameters	Up to 29 parameters	29 parameters
PROPOSED PARAMETERS			
17/18 parameters	17–22 parameters	34 parameters	57 parameters (3 years) 88 parameters (5 years)

	DC–10, F–28, MD–80, ATR–42, EMB–120, SAAB 340, DHC–8, L–1011	737, 747, 757, 767, 777, F–100, MD–11, MD–80, MD–88, MD–90, ATR–72	new type certificates

*FDAU=Flight Data Acquisition Unit

International Compatibility

The FAA has reviewed corresponding International Civil Aviation Organization regulations and Joint Aviation Authority regulations, where they exist. Any differences between those documents and these regulations are of a minor, technical nature, and are deemed insignificant. As noted in the discussion of comments, the review included the technical material for parameters numbered 1 through 57. Beyond parameter 57, no international standards exist. The differences noted above will not adversely affect harmonization.

Paperwork Reduction Act

This final rule contains information collections which are subject to review by OMB under the Paperwork Reduction Act of 1995 (Pub. L. 104–13). The title, description, and respondent description of the annual burden are shown below.

Title: Revisions to Digital Flight Data Recorders Rules.

Description: This regulation revises and updates the Federal Aviation Regulations to require that certain airplanes be equipped to accommodate additional digital flight data recorder (DFDR) parameters. These revisions follow a series of safety recommendations issued by the National Transportation Safety Board (NTSB), and the Federal Aviation Administration's (FAA) decision that the DFDR rules should be revised to upgrade recorder capabilities in most transport airplanes. These revisions will require additional information to be collected to enable more thorough accident or incident investigation and to enable industry to predict certain trends and make necessary modifications before an accident or incident occurs.

Description of Respondents: Businesses or other for profit organizations.

There are no annual reporting or recordkeeping burdens associated with this rule. The information is collected automatically, electronically. It is retained for only 25 hours, and is overwritten on a continuing basis. In the event of an accident or incident, the information is downloaded by the NTSB as a part of its statutory mission. The airplane operators are not required to keep the information, nor to report it.

Cost estimates shown here are aggregates for the entire 4-year compliance time frame. In determining capital and start-up costs to the airline industry, the FAA has assumed that in determining the figures, commercial airline operators took into account the annualized expected useful life of the equipment to be installed in their aircraft. Total capital investment costs, as detailed in the Regulatory Evaluation are estimated at $155.4 million ($131.6 million discounted), and engineering costs are estimated at $3.2 million ($2.7 million discounted). Other costs, which include recurrent and nonrecurrent maintenance costs and costs associated with retrieving information from DFDR units following an accident or incident, are estimated at $16.4 million ($11.4 million discounted).

The agency solicits public comment on the information collection requirements in order to: (1) Evaluate whether the proposed collection of information is necessary for the proper performance of the functions of the agency, including whether the information will have practical utility; (2) evaluate the accuracy of the agency's estimate of the burden of the proposed collection of information, including the validity of the methodology and assumptions used; (3) enhance the quality, utility, and clarity of the information to be collected; and (4) minimize the burden of the collection of information on those who are to respond, including through the use of appropriate automated, electronic, mechanical, or other technological collection techniques or other forms of information technology.

Regulatory Evaluation Summary

Changes to Federal regulations must undergo several economic analyses. First, Executive Order 12866 directs that each Federal agency shall propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic effect of regulatory changes on small entities. Third, the Office of Management and Budget directs agencies to assess the effect of regulatory changes on international trade.

With regard to Executive Order 12866, the FAA determined that this rulemaking is significant because of the substantial public interest in obtaining flight data and the NTSB's ability to conduct full investigations. Accordingly, the FAA evaluated two alternative approaches. In consideration of these alternatives, the FAA has concluded that (1) shortening the compliance time frame to two years as analyzed in the NPRM, would increase the cost of this rulemaking by as much as $170.6 million, discounted; and (2) adopting a simulator methodology to obtain more DFDR parametric detail, although less costly, would not measure all parameters specified in this final rule, nor satisfactorily meet the needs of the NTSB. Hence, the FAA has rejected both of these alternative approaches.

With regard to the Regulatory Flexibility Act of 1980, the FAA has determined that a substantial number of small entities will not be significantly affected economically by this final rule. With regard to the OMB directive, the FAA has concluded that this final rule could have a potential, but insignificant, indirect affect on international trade. A full regulatory evaluation of the final rule providing a detailed discussion of the costs and benefits summarized in this section is available in the docket for this rulemaking action.

Costs

To obtain representative and comprehensive information from which to develop the industry costs of this final rule, the FAA relied on the responses of the Air Transport Association (ATA) and the Regional Airline Association (RAA) members to an air carrier cost survey developed by the ARAC working group. (The FAA augmented this information with adjusted cost analyses from the recently effectively commuter rule). The principle aggregate costs detailed in the cost survey were (1) equipment and inventory/spares; (2) engineering, installation, and other costs, inclusive of recurrent maintenance costs; and (3) aircraft out-of-service costs, which reflect net operating revenue losses resulting from unscheduled aircraft downtime.

The FAA estimates that total costs for air carriers operating turbojets under part 121 would equal $308.9 million ($259.1 million, discounted) within the 4-year compliance time frame of this rulemaking. The equivalent total turboprop fleet costs for air carriers operating under part 121 are estimated to be $30.4 million ($25.8 million, discounted) under the same 4-year compliance time frame. Estimates of the total 4-year compliance time frame costs for part 135, 10–19 seat aircraft required to operate under part 121 as of March 1997 are $26.4 million ($22.3 million, discounted) and for part 135, 20–30 seat aircraft, are $10.9 million ($9.2 million, discounted). Total part 135 costs are $37.3 million ($31.5 million, discounted). Thus, the estimated total 4-year compliance time frame discounted costs for the retrofits required under this final rule are $316.3 million.

The costs associated with upgrading the industry's turbojet fleet with the new DFDR requirements are in excess of 80 percent of the total air carrier industry costs (turbojets, turboprops and part 135 airplanes required to begin operating under part 121 in 1997). Just over 20 percent of the total turbojet fleet costs ($70.1 million; $59.4 million, discounted) are out-of-service costs or lost net operating revenues that result from this rulemaking. No similar estimates of the out-of-service costs were provided to the FAA for either the turboprop fleet or part 135 carriers that will now be required to operate under part 121. Proportionately however, the FAA does not expect these to be significantly different than those estimated for the turbojet fleet.

allowed for the development of integrated maintenance and training programs predicated on the additional information being collected. It has also allowed for more rapid and comprehensive detail to be obtained by the FAA and NTSB in certain recent airplane accidents. The inherent benefits resulting from this rulemaking will evolve as all commercial air carriers adopt the required DFDR enhancements in their airplanes.

Although DFDR's do not in and of themselves prevent accidents, through their use as an investigative tool when accidents or incidents do occur, trends that may adversely affect flight operations in certain airplanes can be determined. Accident investigators in obtaining a greater understanding of the accident dynamics from the DFDR information, can, in turn, be used to more easily determine the probable causes of accidents and incidents. With this knowledge, a ''fix'' can be developed to reduce the chance of a similar occurrence in the future.

In the second instance noted above, although the FAA is not able to quantify precisely the likely benefits that will ultimately result from this rulemaking, the FAA anticipates that the DFDR enhancements required by this final rule will lead to a reduction in accidents and a saving of lives. As a result of analyzing incidents involving aircraft with DFDR enhancements in place, the FAA finds that there is a reasonable prospect that as many as 1.43 accidents could be prevented over the next 20 years. This could save up to 143 lives. The FAA anticipates that, particularly in light of the NTSB recommendations, information concerning enhanced parameters can be collected cost-effectively; it is also expected that the FAA will be able to use incident information to reduce accidents of the nature that are currently of undetermined cause.

Benefit Cost Comparison

The FAA cautions that the cost analysis detailed in the preceding sections is not necessarily exhaustive. The purpose of this rulemaking is to require the installation of DFDR's that record more flight information. This in turn, will allow industry to recognize certain trends in order to make any necessary modifications to avoid future accidents or incidents. Thus, the FAA presumes that, as a result of this rulemaking, the quantity and quality of information will increase. To the extent that NTSB is able to make findings of probable cause in the event of accidents or incidents, the FAA will be able to determine what, if any, appropriate additional action is needed to prevent a recurrence of those kinds of accidents or incidents.

Future FAA actions could take the form of Advisory Circulars, Airworthiness Directives, or possibly, additional rulemaking. The costs of these follow-on FAA actions could vary from negligible costs to considerable costs of some unknown amount. While the costs of such future follow-on actions by the FAA might be considered part of the costs of this rulemaking, the FAA cannot estimate the costs of these unknown future actions. The FAA acknowledges that, to the extent that the costs of any follow-on actions are more than negligible, the current cost estimates would tend to underestimate the total cost of this rulemaking.

Public Comments on Economic Issues in the NPRM

The FAA received comments from twenty-six parties in response to the published DFDR NPRM. Most of the comments concerned engineering and other technical detail germane to the reconfiguration requirements; fewer comments presented any detailed economic considerations of the proposed rule. This was expected since the regulatory evaluation and economic analysis were derived from the airline-specific cost information as provided through the ATA and RAA, both of which participated in the ARAC process. The comments containing more specific economic content are summarized below.

Several commenters addressed specific issues with regard to airplanes currently operating under part 135. Piedmont Airlines notes that the recorders currently used in its ATR–72 record 98 parameters and those used in its SAAB 340 record 128 parameters. In both cases, certain of the parameters specified by this rulemaking are not currently being recorded but could be derived; the cost however, to retrofit these airplanes to be in compliance would be about $100,000 per aircraft. Similarly, Aerospatiale and

as costing $110,000, 1200 man-hours, and 2.5 weeks downtime per aircraft.

In another statement submitted with the RAA comment, Comair believes the recorder capabilities currently employed on its in-service fleet far exceed those of the rulemaking's ''target aircraft'', e.g., older 737's and DC–9's. Comair also provided retrofit cost data for its fleet of 40 Embraer EMB 120 aircraft ($51,450 and 6 days downtime per aircraft) and its fleet of 70 Canadair CL600–2B19 regional jets ($136,600 and 6 days downtime per aircraft). Although not part of the RAA comment and attachments, Embraer also provided detailed cost information for the retrofitting of the EMB–120 aircraft under each of the categories specified in the rule. Embraer's retrofit cost estimates are more in line with those presented in the NPRM and considerably less than those cited above.

A statement from USAir Express notes that the cost data submitted by the RAA were primarily for aircraft operated by RAA members under part 121, not part 135 as estimated in the regulatory evaluation; only the EMB–120 is operated exclusively under part 135. As a consequence, RAA/USAir Express suggest that the FAA cost estimates for retrofitting aircraft operating under part 121 are from 5 percent to 10 percent low.

Finally, Twin Otter International (TOIL) contends that the DHC–6–300, which is no longer in production, was not designed for FDR's and no engineering data exists to support an FDR installation. TOIL estimates the costs to redesign the DHC–6–300 aircraft systems and recertify would be in excess of $130,000, and deHavilland, the Twin Otter manufacturer, has no interest in participating in the cost of certifying/retrofitting the DHC–6–300. TOIL concludes that application of the rule would inhibit the ability of U.S. operators to purchase additional aircraft, particularly since the majority of available Twin Otters are registered outside the U.S.

FAA Response: The FAA appreciates the additional cost detail regarding aircraft operating under part 135 as provided in these comments, as well as the clarification of the cost detail as provided by the RAA. The FAA relied heavily on ARAC working group members to supply accurate and timely cost detail and economic information. This reliance also assumed that the cost detail supplied clearly delineated the retrofit costs associated with aircraft operating under part 135 from those operating under part 121.

With regard to the so-called ''requirements flexibility'' or possible exemption of certain aircraft, this is not a matter for consideration in the regulatory evaluation. It should be noted that the ARAC working group, with significant industry input, concluded that the differences between the NTSB recommendations and ED–55 would be insignificant for U.S. operators. Finally, with regard to the DHC–6–300 airplane (the Twin Otter) the FAA received sufficient information to support the exemption of these aircraft operated under part 135. Section 135.152(k) was added to provide that exemption.

Several comments were received regarding the 88 parameter list for airplanes in category V (those that will be manufactured five years after the effective date of this rule), most of which noted the absence of a detailed cost/benefit analysis specific to this requirement for future newly manufactured aircraft. Airbus Industrie notes an inexact match between the 88 or more parameters currently being recorded by some European manufacturers of FDRs and those on the NTSB list. This is also true of the currently operational A300–600/310 and A319/320/321 aircraft which can record up to 270 parameters and the A330/A340 models which can record up to 400 parameters.

The Air Line Pilots Association (ALPA) notes that the cost data supplied by ATA and RAA was inclusive only up to 57 parameters (category IV), but contends that there is no justifiable technical or economic reason not to include 88 parameters 3 years (not 5 years) after the promulgation of the final rule as is the case with the 57 parameter group. Fairchild Aircraft disagrees with the position that newly manufactured 10–19 seat airplanes should be required to have either 57 parameters within 3 to 5 years after issuance of the final rule or 88 parameters 5 years after issuance of the final rule. Fairchild Aircraft also maintains that compliance with § 135.152 is more than adequate for airplanes operating under part 135. Fairchild Aircraft, one of two U.S. manufacturers of commuter category airplanes also included aggregate recurring and non-recurring cost estimates for retrofitting its Metro 23 airplane

the generally speculative nature that would be required of air carriers in developing macro cost breakouts for newly manufactured airplanes in the future. These impediments were recognized by the ARAC working group, and, as a consequence, no request for this information was tendered.

With regard to the remaining issues noted above concerning the parameter requirements of newly manufactured airplanes, the potential cost burden, and the apparent excessive cost/benefit ratio, Federal regulations in general, require only that the complete rule be subjected to a cost/benefit analysis, not its component parts. Furthermore, although the cost information provided by ATA and RAA allowed detailed analysis of the first three aircraft categories, an analysis of the benefits cannot be estimated in similar manner; benefits therefore, were determined for the overall rule. Finally, as noted in the preamble, cost alone cannot justify ignoring the recognized potential safety gains inherent in this rule, the inclusion of certain airplanes now operating under part 135 to comply with the requirements of part 121 is a result of the commuter or ''one level of safety'' rule.

With regard to parts vendors and the disaggregation of materials costs, comments were received from two suppliers (Flight Systems Engineering, Inc. and Patriot Sensors and Controls Corporation) and one trade association (Airlines Pilot Association (ALPA)). The vendors' comments addressed the costs of specific equipment components and the lead time required to meet orders. A portion of ALPA's comments focused on the need for a more extensive review of cost data and recommended contacting individual manufacturers of FDRs and FDAUs.

FAA Response: The FAA appreciates the logistics information regarding vendor lead times which are well within the 4-year compliance time of this final rule. The FAA however, notes that the cost data developed for this rulemaking was provided by ATA and RAA at the aggregate level; it does not lend itself to the micro detail of specific retrofit components. No changes to the regulatory evaluation or the rule were made in response to these comments.

Finally, a comment was submitted by the Department of Civil and Environmental Engineering of the University of West Virginia (WVU) proposing an alternative approach to the retrofitting requirements of this rule based on Artificial Intelligence, or more specifically, Neural Network theory. Relying on an alternate set of assumptions, the WVU team estimates the cost of the DFDR final rule at $1.046 billion, or more than three times the FAA estimate, and offers their software-based system, the Virtual Flight Data Recorder (VFDR), as a low-cost alternative. Utilizing the data taken from an existing conventional 11-parameter FDR, the VFDR, according to the WVU team, would accurately ''reconstruct'' most of the additional parameters detailed in the final rule via a Neural Network mapping process at a cost of about $800–$1,000 per aircraft, or about 1 percent of their cost estimate for this final rule. The WVU comment concludes that the opportunity cost of the hard retrofit is lost savings which could be invested in a variety of safety enhancements.

FAA Response: The FAA appreciates the efforts of the WVU team in presenting an innovative, low-cost ''simulator'' alternative to the hardware retrofits that will be required by this rule. However, the rulemaking is concerned with expanding the number of parameters to be recorded as requested by the NTSB, not with revising the means by which additional data can be collected. The NTSB has made it clear that its requirements must be met by direct parametric measurement via recorder, and has not supported industry comments with respect to parameter redundancy or inference from parameters already recorded. The FAA supports the continued efforts on the part of the WVU team to disseminate VFDR information to the NTSB, FAA Research Office and airline industry. The FAA, through this rulemaking, takes no position at this time on the VFDR or the commenter's measurement of the opportunity costs of this final rule.

Final Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily or disproportionately burdened by Federal regulations. The RFA requires regulatory agencies to review rules which may have ''a significant economic impact on a substantial number of

than or equal to 60 seats; and (3) $4,900 (1995 dollars) in the case of unscheduled operators of aircraft for hire.

The FAA has determined the annualized costs (20 years) for scheduled operators of large aircraft to be $5,611 per aircraft. Multiplying this estimate by 9, (the upper bound of the small entity criteria) yields a result of $50,501. This estimate is significantly below the minimum compliance cost criteria of $122,400 for scheduled operators of large aircraft.

The FAA has also determined the annualized costs (20 years) for scheduled operators of small aircraft to be $3,067 per aircraft. The upper bound costs for consideration within the small entity (9 aircraft) criteria are $27,603, which is well below the minimum compliance cost of $69,800. Thus, the FAA has determined that a substantial number of small entities will not be significantly affected by this final rule.

International Trade Impact Assessment

The FAA anticipates that revisions to digital flight data recorder rules could have some indirect affect on international trade. The FAA finds that while the final rule will not effect non-U.S. operators of foreign aircraft operating outside the United States, it could affect the suppliers of materials required for retrofitting the affected aircraft in the domestic fleet. Domestic sources of the required retrofit components may not be able to meet all of the increased demand of the domestic air carriers for DFDR's as these air carriers increase their orders to meet the compliance time frame for these regulations. Foreign producers may benefit by supplying the unfilled orders.

Conclusion

For the reasons discussed in the preamble, and based on the findings in the Regulatory Flexibility Determination and the International Trade Impact Analysis, the FAA has determined that this final rule is a significant regulatory action under Executive Order 12866. In addition, the FAA certifies that this rule will not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act. This rule is considered significant under Department of Transportation Order 2100.5, Policies and Procedures for Simplification, Analysis, and Review of Regulations. A regulatory evaluation of the rule, including a Regulatory Flexibility Determination and International Trade Impact Analysis, has been placed in the docket. A copy may be obtained by contacting the person identified under the heading "FOR FURTHER INFORMATION CONTACT."

The Amendment

In consideration of the foregoing, the Federal Aviation Administration amends 14 CFR parts 121, 125, 129 and 135 of the Federal Aviation Regulations effective August 18, 1997.

The authority citation for part 135 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701–44702, 44705, 44709, 44711–44713, 44715–44717, 44722.

§ 135.141 Applicability.

This subpart prescribes aircraft and equipment requirements for operations under this part. The requirements of this subpart are in addition to the aircraft and equipment requirements of part 91 of this chapter. However, this part does not require the duplication of any equipment required by this chapter.

§ 135.143 General requirements.

(a) No person may operate an aircraft under this part unless that aircraft and its equipment meet the applicable regulations of this chapter.

(b) Except as provided in § 135.179, no person may operate an aircraft under this part unless the required instruments and equipment in it have been approved and are in an operable condition.

(c) ATC transponder equipment installed within the time periods indicated below must meet the performance and environmental requirements of the following TSO's.

(1) *Through January 1, 1992:*

(i) Any class of TSO–C74b or any class of TSO–C74c as appropriate, provided that the equipment was manufactured before January 1, 1990; or

(ii) The appropriate class of TSO–C112 (Mode S).

(2) *After January 1, 1992:* The appropriate class of TSO–C112 (Mode S). For purposes of paragraph (c)(2) of this section, ''installation'' does not include—

(i) Temporary installation of TSO–C74b or TSO–C74c substitute equipment, as appropriate, during maintenance of the permanent equipment;

(ii) Reinstallation of equipment after temporary removal for maintenance; or

(iii) For fleet operations, installation of equipment in a fleet aircraft after removal of the equipment for maintenance from another aircraft in the same operator's fleet.

(Amdt. 135–22, Eff. 5/26/87)

§ 135.145 Aircraft proving tests.

(a) No certificate holder may operate a turbojet airplane, or an aircraft for which two pilots are required by this chapter for operations under VFR, if it has not previously proved that aircraft or an aircraft of the same make and similar design in any operation under this part unless, in addition to the aircraft certification tests, at least 25 hours of proving tests acceptable to the Administrator have been flown by that certificate holder including—

(1) Five hours of night time, if night flights are to be authorized;

(2) Five instrument approach procedures under simulated or actual instrument weather conditions, if IFR flights are to be authorized; and

(3) Entry into a representative number of en route airports as determined by the Administrator.

(b) No certificate holder may carry passengers in an aircraft during proving tests, except those needed to make the tests and those designated by the Administrator to observe the tests. However, pilot flight training may be conducted during the proving tests.

(c) For the purposes of paragraph (a) of this section, an aircraft is not considered to be of similar design if an alteration includes—

(1) The installation of powerplants other than those of a type similar to those with which it is certificated; or

(2) Alterations to the aircraft or its components that materially affect flight characteristics.

(d) The Administrator may authorize deviations from this section if the Administrator finds that special circumstances make full compliance with this section necessary.

§ 135.147 Dual controls required.

No person may operate an aircraft in operations requiring two pilots unless it is equipped with functioning dual controls. However, if the aircraft type certification operating limitations do not require two pilots, a throwover control wheel may be used in place of two control wheels.

(b) Heating or deicing equipment for each carburetor or, for a pressure carburetor, an alternate air source;

(c) For turbojet airplanes, in addition to two gyroscopic bank-and-pitch indicators (artificial horizons) for use at the pilot stations, a third indicator that is installed in accordance with the instrument requirements prescribed in § 121.305(j) of this chapter.

(d) [Reserved]

(e) For turbine-powered aircraft, any other equipment as the Administrator may require.

(Amdt. 135–1, Eff. 5/7/79); (Amdt. 135–34, Eff. 11/27/89); (Amdt. 135–38, Eff. 11/26/90)

§ 135.150 Public address and crewmember interphone systems.

No person may operate an aircraft having a passenger seating configuration, excluding any pilot seat, of more than 19 unless it is equipped with—

(a) A public address system which—

(1) Is capable of operation independent of the crewmember interphone system required by paragraph (b) of this section, except for handsets, headsets, microphones, selector switches, and signaling devices;

(2) Is approved in accordance with § 21.305 of this chapter;

(3) Is accessible for immediate use from each of two flight crewmember stations in the pilot compartment;

(4) For each required floor-level passenger emergency exit which has an adjacent flight attendant seat, has a microphone which is readily accessible to the seated flight attendant, except that one microphone may serve more than one exit, provided the proximity of the exits allows unassisted verbal communication between seated flight attendants;

(5) Is capable of operation within 10 seconds by a flight attendant at each of those stations in the passenger compartment from which its use is accessible;

(6) Is audible at all passenger seats, lavatories, and flight attendant seats and work stations; and

microphones, selector switches, and signaling devices;

(2) Is approved in accordance with § 21.305 of this chapter;

(3) Provides a means of two-way communication between the pilot compartment and—

(i) Each passenger compartment; and

(ii) Each galley located on other than the main passenger deck level;

(4) Is accessible for immediate use from each of two flight crewmember stations in the pilot compartment;

(5) Is accessible for use from at least one normal flight attendant station in each passenger compartment;

(6) Is capable of operation within 10 seconds by a flight attendant at each of those stations in each passenger compartment from which its use is accessible; and

(7) For large turbojet-powered airplanes—

(i) Is accessible for use at enough flight attendant stations so that all floor-level emergency exits (or entryways to those exits in the case of exits located within galleys) in each passenger compartment are observable from one or more of those stations so equipped;

(ii) Has an alerting system incorporating aural or visual signals for use by flight crewmembers to alert flight attendants and for use by flight attendants to alert flight crewmembers;

(iii) For the alerting system required by paragraph (b)(7)(ii) of this section, has a means for the recipient of a call to determine whether it is a normal call or an emergency call; and

(iv) When the airplane is on the ground, provides a means of two-way communication between ground personnel and either of at least two flight crewmembers in the pilot compartment. The interphone system station for use by ground personnel must be so located that personnel using the system may avoid visible detection from within the airplane.

Docket No. 24995 (54 FR 43926) Eff. 10/27/89 (Amdt. 135–34, Eff. 11/27/89)

(1) Is installed in compliance with part 23.1457(a)(1) and (2), (b), (c), (d), (e), (f), and (g); § 25.1457(a)(1) and (2), (b), (c), (d), (e), (f), and (g); § 27.1457(a)(1) and (2), (b), (c), (d), (e), (f), and (g); § 29.1457(a)(1) and (2), (b), (c), (d), (e), (f), and (g); of this chapter, as applicable; and

(2) Is operated continuously from the use of the check list before the flight to completion of the final check list at the end of the flight.

(b) [No] person may operate a multiengine, turbine-powered airplane or rotorcraft having a passenger seating configuration of 20 or more seats unless it is equipped with an approved cockpit voice recorder that—

(1) Is installed in compliance with § 23.1457, § 25.1457, § 27.1457 or § 29.1457 of this chapter, as applicable; and

(2) Is operated continuously from the use of the check list before the flight to completion of the final check list at the end of the flight.

(c) In the event of an accident, or occurrence requiring immediate notification of the National Transportation Safety Board which results in termination of the flight, the certificate holder shall keep the recorded information for at least 60 days or, if requested by the Administrator or the Board, for a longer period. Information obtained from the record may be used to assist in determining the cause of accidents or occurrences in connection with investigations. The Administrator does not use the record in any civil penalty or certificate action.

(d) For those aircraft equipped to record the uninterrupted audio signals received by a boom or a mask microphone the flight crewmembers are required to use the boom microphone below 18,000 feet mean sea level. No person may operate a large turbine-engine-powered airplane manufactured after October 11, 1991, or on which a cockpit voice recorder has been installed after October 11, 1991, unless it is equipped to record the uninterrupted audio signal received by a boom or mask microphone in accordance with § 25.1457(c)(5) of this chapter.

(e) In complying with this section, an approved cockpit voice recorder having an erasure feature utes earlier, may be erased or otherwise obliterated.

(Amdt. 135–23, Eff. 5/26/87); (Amdt. 135–26, Eff. 10/11/88); [(Amdt. 135–60, Eff. 2/26/96)]

§ 135.152 Flight recorders.

(a) [Except as provided in paragraph (k) of this section, no person may operate under this part a multi-engine, turbine-engine-powered airplane or rotorcraft having a passenger seating configuration, excluding any required crewmembers seat, of 10 to 19 seats, that was either brought onto the U.S. register after, or was registered outside the United States and added to the operator's U.S. operations specifications after, October 11, 1991, unless it is equipped with one or more approved flight recorders that use a digital method of recording and storing data and a method of readily retrieving that data from the storage medium. The parameters specified in either Appendix B or C of this part, as applicable must be recorded within the range, accuracy, resolution, and recording intervals as specified. The recorder shall retain no less than 25 hours of aircraft operation.]

(b) After October 11, 1991, no person may operate a multiengine, turbine-powered airplane having a passenger seating configuration of 20 to 30 seats or a multiengine, turbine-powered rotorcraft having a passenger seating configuration of 20 or more seats unless it is equipped with one or more approved flight recorders that utilize a digital method of recording and storing data, and a method of readily retrieving that data from the storage medium. The parameters in appendix D or E of this part, as applicable, that are set forth below, must be recorded within the ranges, accuracies, resolutions, and sampling intervals as specified:

(1) Except as provided in paragraph (b)(3) of this section for aircraft type certificated before October 1, 1969, the following parameters must be recorded:

(i) Time;

(ii) Altitude;

(iii) Airspeed;

(iv) Vertical acceleration;

(v) Heading;

(xi) Thrust of each engine.

(2) Except as provided in paragraph (b)(3) of this section for aircraft type certificated after September 30, 1969, the following parameters must be recorded:

(i) Time;

(ii) Altitude;

(iii) Airspeed;

(iv) Vertical acceleration;

(v) Heading;

(vi) Time of each radio transmission either to or from air traffic control;

(vii) Pitch attitude;

(viii) Roll attitude;

(ix) Longitudinal acceleration;

(x) Pitch trim position;

(xi) Control column or pitch control surface position;

(xii) Control wheel or lateral control surface position;

(viii) Rudder pedal or yaw control surface position;

(xiv) Thrust of each engine;

(xv) Position of each thrust reverser;

(xvi) Trailing edge flap or cockpit flap control position; and

(xvii) Leading edge flap or cockpit flap control position.

(3) For aircraft manufactured after October 11, 1991, all of the parameters listed in appendix D or E of this part, as applicable, must be recorded.

(c) Whenever a flight recorder required by this section is installed, it must be operated continuously from the instant the airplane begins the takeoff roll or the rotorcraft begins the lift-off until the airplane has completed the landing roll or the rotorcraft has landed at its destination.

(d) Except as provided in paragraph (c) of this section, and except for recorded data erased as authorized in this paragraph, each certificate holder shall keep the recorded data prescribed in paragraph (a) of this section until the aircraft has been operating for at least [25] hours of the operating time specified in paragraph (c) of this section. In addition, each certificate holder must be erased for the purpose of testing the flight recorder or the flight recorder system. Any erasure made in accordance with this paragraph must be of the oldest recorded data accumulated at the time of testing. Except as provided in paragraph (c) of this section, no record need be kept more than 60 days.

(e) In the event of an accident or occurrence that requires that immediate notification of the National Transportation Safety Board under 49 CFR part 830 of its regulations and that results in termination of the flight, the certificate holder shall remove the recording media from the aircraft and keep the recorded data required by paragraphs (a) and (b) of this section for at least 60 days or for a longer period upon request of the Board or the Administrator.

(f)(1) [For airplanes manufactured on or before August 18, 2000, and all other aircraft, each flight recorder required by this section must be installed in accordance with the requirements of § 23.1459, 25.1459, 27.1459, or 29.1459, as appropriate, of this chapter. The correlation required by paragraph (c) of § 23.1459, 25.1459, 27.1459, or 29.1459, as appropriate, of this chapter need be established only on one aircraft of a group of aircraft:

[(i) That are of the same type;

[(ii) On which the flight recorder models and their installations are the same; and

[(iii) On which there are no differences in the type designs with respect to the installation of the first pilot's instruments associated with the flight recorder. The most recent instrument calibration, including the recording medium from which this calibration is derived, and the recorder correlation must be retained by the certificate holder.

[(f)(2) For airplanes manufactured after August 18, 2000, each flight data recorder system required by this section must be installed in accordance with the requirements of § 23.1459(a), (b), (d) and (e) of this chapter, or § 25.1459(a), (b), (d), and (e) of this chapter. A correlation must be established between the values recorded by the flight data recorder and the corresponding values being measured. The correlation must contain a sufficient number of correlation points to accurately establish the conversion from the recorded values to engineering

[(ii) On which the flight recorder system and its installation are the same; and

[(iii) On which there is no difference in the type design with respect to the installation of those sensors associated with the flight data recorder system. Documentation sufficient to convert recorded data into the engineering units and discrete values specified in the applicable appendix must be maintained by the certificate holder.]

(g) Each flight recorder required by this section that records the data specified in paragraphs (a) and (b) of this section must have an approved device to assist in locating that recorder under water.

[(h) The operational parameters required to be recorded by digital flight data recorders required by paragraphs (i) and (j) of this section are as follows: the phrase "when an information source is installed" following a parameter indicates that recording of that parameter is not intended to require a change in installed equipment.

[(1) Time;

(2) Pressure altitude;

(3) Indicated airspeed;

(4) Heading—primary flight crew reference (if selectable, record discrete, true or magnetic);

(5) Normal acceleration (Vertical);

(6) Pitch attitude;

(7) Roll attitude;

(8) Manual radio transmitter keying, or CVR/DFDR synchronization reference;

(9) Thrust/power of each engine—primary flight crew reference;

(10) Autopilot engagement status;

(11) Longitudinal acceleration;

(12) Pitch control input;

(13) Lateral control input;

(14) Rudder pedal input;

(15) Primary pitch control surface position;

(16) Primary lateral control surface position;

(17) Primary yaw control surface position;

(18) Lateral acceleration;

(19) Pitch trim surface position or parameters of paragraph (h)(82) of this section if currently recorded;

(23) Ground spoiler position or speed brake selection (except when parameters of paragraph (h)(87) of this section apply);

(24) Outside or total air temperature;

(25) Automatic Flight Control System (AFCS) modes and engagement status, including autothrottle;

(26) Radio altitude (when an information source is installed);

(27) Localizer deviation, MLS Azimuth;

(28) Glideslope deviation, MLS Elevation;

(29) Marker beacon passage;

(30) Master warning;

(31) Air/ground sensor (primary airplane system reference nose or main gear);

(32) Angle of attack (when information source is installed);

(33) Hydraulic pressure low (each system);

(34) Ground speed (when an information source is installed);

(35) Ground proximity warning system;

(36) Landing gear position or landing gear cockpit control selection;

(37) Drift angle (when an information source is installed);

(38) Wind speed and direction (when an information source is installed);

(39) Latitude and longitude (when an information source is installed);

(40) Stick shaker/pusher (when an information source is installed);

(41) Windshear (when an information source is installed);

(42) Throttle/power lever position;

(43) Additional engine parameters (as designated in appendix F of this part);

(44) Traffic alert and collision avoidance system;

(45) DME 1 and 2 distances;

(46) Nav 1 and 2 selected frequency;

(47) Selected barometric setting (when an information source is installed);

(48) Selected altitude (when an information source is installed);

source is installed);

(53) Selected flight path (when an information source is installed);

(54) Selected decision height (when an information source is installed);

(55) EFIS display format;

(56) Multi-function/engine/alerts display format;

(57) Thrust command (when an information source is installed);

(58) Thrust target (when an information source is installed);

(59) Fuel quantity in CG trim tank (when an information source is installed);

(60) Primary Navigation System Reference;

(61) Icing (when an information source is installed);

(62) Engine warning each engine vibration (when an information source is installed);

(63) Engine warning each engine over temp. (when an information source is installed);

(64) Engine warning each engine oil pressure low (when an information source is installed);

(65) Engine warning each engine over speed (when an information source is installed;

(66) Yaw trim surface position;

(67) Roll trim surface position;

(68) Brake pressure (selected system);

(69) Brake pedal application (left and right);

(70) Yaw or sideslip angle (when an information source is installed);

(71) Engine bleed valve position (when an information source is installed);

(72) De-icing or anti-icing system selection (when an information source is installed);

(73) Computed center of gravity (when an information source is installed);

(74) AC electrical bus status;

(75) DC electrical bus status;

(76) APU bleed valve position (when an information source is installed);

(77) Hydraulic pressure (each system);

(78) Loss of cabin pressure;

(79) Computer failure;

(80) Heads-up display (when an information source is installed);

(86) Leading edge flap and cockpit flap control position;

(87) Ground spoiler position and speed brake selection; and

(88) All cockpit flight control input forces (control wheel, control column, rudder pedal).

[(i) For all turbine-engine-powered airplanes with a seating configuration, excluding any required crewmember seat, of 10 to 30 passenger seats, manufactured after August 18, 2000—

[(1) The parameters listed in paragraphs (h)(1) through (h)(57) of this section must be recorded within the ranges, accuracies, resolutions, and recording intervals specified in Appendix F of this part.

[(2) Commensurate with the capacity of the recording system, all additional parameters for which information sources are installed and which are connected to the recording system must be recorded within the ranges, accuracies, resolutions, and sampling intervals specified in Appendix F of this part.

[(j) For all turbine-engine-powered airplanes with a seating configuration, excluding any required crewmember seat, of 10 to 30 passenger seats, that are manufactured after August 19, 2002, the parameters listed in paragraphs (a)(1) through (a)(88) of this section must be recorded within the ranges, accuracies, resolutions, and recording intervals specified in Appendix F of this part.

[(k) For airplanes manufactured before August 18, 1997, the following airplane type need not comply with this section: deHavilland DHC–6.]

Docket No. 25530 (53 FR 26151) Eff. 7/11/88; (Amdt. 135–26, Eff. 10/11/88); [(Amdt. 135–69, Eff. 8/18/97)]

§ 135.153 Ground proximity warning system.

(a) [No person may operate a turbine-powered airplane having a passenger seat configuration of 10 seats or more, excluding any pilot seat, unless it is equipped with an approved ground proximity warning system.]

(b) [Reserved]

the Administrator;

(2) The system must have a means of alerting the pilot when a malfunction occurs in the system; and

(3) Procedures must have been established by the certification holder to ensure that the performance of the system can be appropriately monitored.

(c) For a system required by this section, the Airplane Flight Manual shall contain—

(1) Appropriate procedures for—

(i) The use of the equipment;

(ii) Proper flight crew action with respect to the equipment; and

(iii) Deactivation for planned abnormal and emergency conditions; and

(2) An outline of all input sources that must be operating.

(d) No person may deactivate a system required by this section except under procedures in the Airplane Flight Manual.

(e) Whenever a system required by this section is deactivated, an entry shall be made in the airplane maintenance record that includes the date and time of deactivation.

(Amdt. 135–6, Eff. 9/10/80); (Amdt. 135–33, Eff. 10/25/89); (Amdt. 135–42, Eff. 4/20/92); (Amdt. 135–60, Eff. 2/26/96); [(Amdt. 135–66, Eff. 3/12/97)]

§ 135.155 Fire extinguishers: Passenger-carrying aircraft.

No person may operate an aircraft carrying passengers unless it is equipped with hand fire extinguishers of an approved type for use in crew and passenger compartments as follows—

(a) The type and quantity of extinguishing agent must be suitable for all the kinds of fires likely to occur;

(b) At least one hand fire extinguisher must be provided and conveniently located on the flight deck for use by the flight crew; and

(c) At least one hand fire extinguisher must be conveniently located in the passenger compartment of each aircraft having a passenger seating configu-

oxygen dispensers and oxygen to supply the pilots under § 135.89(a) and to supply, when flying—

(1) At altitudes above 10,000 feet through 15,000 feet MSL, oxygen to at least 10 percent of the occupants of the aircraft, other than the pilots, for that part of the flight at those altitudes that is of more than 30 minutes duration; and

(2) Above 15,000 feet MSL oxygen to each occupant of the aircraft other than the pilots.

(b) *Pressurized aircraft.* No person may operate a pressurized aircraft

(1) At altitudes above 25,000 feet MSL, unless at least a 10-minute supply of supplemental oxygen is available for each occupant of the aircraft, other than the pilots, for use when a descent is necessary due to loss of cabin pressurization; and

(2) Unless it is equipped with enough oxygen dispensers and oxygen to comply with paragraph (a) of this section whenever the cabin pressure altitude exceeds 10,000 feet MSL and, if the cabin pressurization fails, to comply with § 135.89(a) or to provide a 2-hour supply for each pilot, whichever is greater, and to supply when flying—

(i) At altitudes above 10,000 feet through 15,000 feet MSL, oxygen to at least 10 percent of the occupants of the aircraft, other than the pilots, for that part of the flight at those altitudes that is of more than 30 minutes duration; and

(ii) Above 15,000 feet MSL, oxygen to each occupant of the aircraft, other than the pilots, for one hour unless, at all times during flight above that altitude, the aircraft can safely descend to 15,000 feet MSL within four minutes, in which case only a 30-minute supply is required.

(c) The equipment required by this section must have a means—

(1) To enable the pilots to readily determine, in flight, the amount of oxygen available in each source of supply and whether the oxygen is being delivered to the dispensing units; or

(2) In the case of individual dispensing units, to enable each user to make those determinations

(a) Except as provided in paragraph (b) of this section, after April 12, 1981, no person may operate a transport category airplane equipped with a flight instrument pitot heating system unless the airplane is also equipped with an operable pitot heat indication system that complies with § 25.1326 of this chapter in effect on April 12, 1978.

(b) A certificate holder may obtain an extension of the April 12, 1981, compliance date specified in paragraph (a) of this section, but not beyond April 12, 1983, from the Director, Flight Standards Service if the certificate holder—

(1) Shows that due to circumstances beyond its control it cannot comply by the specified compliance date; and

(2) Submits by the specified compliance date a schedule for compliance, acceptable to the Director, indicating that compliance will be achieved at the earliest practicable date.

(Amdt. 135–17, Eff. 9/30/81); (Amdt. 135–33, Eff. 10/25/89)

§ 135.159 Equipment requirements: Carrying passengers under VFR at night or under VFR over-the-top conditions.

No person may operate an aircraft carrying passengers under VFR at night or under VFR over-the-top unless it is equipped with—

(a) A gyroscopic rate-of-turn indicator except on the following aircraft:

(1) Airplanes with a third attitude instrument system usable through flight attitudes of 360 degrees of pitch-and-roll and installed in accordance with the instrument requirements prescribed in § 121.3056) of this chapter.

(2) Helicopters with a third attitude instrument system usable through flight attitudes of ±80 degrees of pitch and ±120 degrees of roll and installed in accordance with § 29.1303(g) of this chapter.

(3) Helicopters with a maximum certificated takeoff weight of 6,000 pounds or less.

(b) A slip skid indicator.

(c) A gyroscopic bank-and-pitch indicator.

(d) A gyroscopic direction indicator.

switches, and gauges easily readable, the direct rays of which are shielded from the pilot's eyes; and

(3) A flashlight having at least two size "D" cells or equivalent.

(g) For the purpose of paragraph (e) of this section, a continuous in-flight electrical load includes one that draws current continuously during flight, such as radio equipment, electrically driven instruments and lights, but does not include occasional intermittent loads.

(h) Notwithstanding provisions of paragraphs (b), (c), and (d), helicopters having a maximum certificated takeoff weight of 6,000 pounds or less may be operated until January 6, 1988, under visual flight rules at night without a slip skid indicator, a gyroscopic bank-and-pitch indicator, or a gyroscopic direction indicator.

Docket No. 24550 (51 FR 40709) Eff. 11/7/86);

(Amdt. 135–20, Eff. 1/6/87); (Amdt. 135–38, Eff. 11/26/90)

§ 135.161 Radio and navigational equipment: Carrying passengers under VFR at night or under VFR over-the-top.

(a) No person may operate an aircraft carrying passengers under VFR at night, or under VFR over-the-top, unless it has two-way communications equipment able, at least in flight, to transmit to, and receive from, ground facilities 25 miles away.

(b) No person may operate an aircraft carrying passengers under VFR over-the-top unless it has radio navigational equipment able to receive radio signals from the ground facilities to be used.

(c) No person may operate an airplane carrying passengers under VFR at night unless it has radio navigational equipment able to receive radio signals from the ground facilities to be used.

§ 135.163 Equipment requirements: Aircraft carrying passengers under IFR.

No person may operate an aircraft under IFR, carrying passengers, unless it has—

(a) A vertical speed indicator;

(b) A free-air temperature indicator;

tors;

(f) For a single-engine aircraft, a generator or generators able to supply all probable combinations of continuous inflight electrical loads for required equipment and for recharging the battery;

(g) For multiengine aircraft, at least two generators each of which is on a separate engine, of which any combination of one-half of the total number are rated sufficiently to supply the electrical loads of all required instruments and equipment necessary for safe emergency operation of the aircraft except that for multiengine helicopters, the two required generators may be mounted on the main rotor drive train; and

(h) Two independent sources of energy (with means of selecting either), of which at least one is an engine-drive pump or generator, each of which is able to drive all gyroscopic instruments and installed so that failure of one instrument or source does not interfere with the energy supply to the remaining instruments or the other energy source, unless, for single-engine aircraft, the rate-of-turn indicator has a source of energy separate from the bank and pitch and direction indicators. For the purpose of this paragraph, for multiengine aircraft, each engine-driven source of energy must be on a different engine.

(i) For the purpose of paragraph (f) of this section, a continuous inflight electrical load includes one that draws current continuously during flight, such as radio equipment, electrically driven instruments, and lights, but does not include occasional intermittent loads.

§ 135.165 Radio and navigational equipment: Extended overwater or IFR operations.

(a) No person may operate a turbojet airplane having a passenger seating configuration, excluding any pilot seat, of 10 seats or more, or a multiengine airplane in a commuter operation, as defined in part 119 of this chapter, under IFR or in extended overwater operations unless it has at least the following radio communication and navigational equipment appropriate to the facilities to be used which are capable of transmitting to and receiving

(b) No person may operate an aircraft other than that specified in paragraph (a) of this section, under IFR or in extended overwater operations unless it has at least the following radio communication and navigational equipment appropriate to the facilities to be used and which are capable of transmitting to, and receiving from, at any place on the route, at least one ground facility:

(1) A transmitter, (2) two microphones, (3) two headsets or one headset and one speaker, (4) a marker beacon receiver, (5) two independent receivers for navigation, (6) two independent receivers for communications, and (7) for extended overwater operations only, an additional transmitter.

(c) For the purpose of paragraphs (a)(5), (a)(6), (b)(5), and (b)(6) of this section, a receiver is independent if the function of any part of it does not depend on the functioning of any part of another receiver. However, a receiver that can receive both communications and navigational signals may be used in place of a separate communications receiver and a separate navigational signal receiver.

[(d) Notwithstanding the requirements of paragraphs (a) and (b) of this section, installation and use of a single long-range navigation system and a single long-range communication system, for extended overwater operations, may be authorized by the Administrator and approved in the certificate holder's operations specifications. The following are among the operational factors the Administrator may consider in granting an authorization: (1) the ability of the flightcrew to reliably fix the position of the airplane within the degree of accuracy required by ATC, (2) the length of the route being flown, and (3) the duration of the very high frequency communications gap.]

(Amdt. 135–58, Eff. 1/19/96); [(Amdt. 135–61, Eff. 2/26/96)]

§ 135.167 Emergency equipment: Extended overwater operations.

(a) No person may operate an aircraft in extended overwater operations unless it carries, installed in conspicuously marked locations easily accessible to the occupants if a ditching occurs, the following equipment:

(b) Each life raft required by paragraph (a) of this section must be equipped with or contain at least the following:

(1) One approved survivor locator light.

(2) One approved pyrotechnic signaling device.

(3) Either—

(i) One survival kit, appropriately equipped for the route to be flown; or

(ii) One canopy (for sail, sunshade, or rain catcher);

(iii) One radar reflector;

(iv) One life raft repair kit;

(v) One bailing bucket;

(vi) One signaling mirror;

(vii) One police whistle;

(viii) One raft knife;

(ix) One CO_2 bottle for emergency inflation;

(x) One inflation pump;

(xi) Two oars;

(xii) One 75-foot retaining line;

(xiii) One magnetic compass;

(xiv) One dye marker;

(xv) One flashlight having at least two size "D" cells or equivalent;

(xvi) A two-day supply of emergency food rations supplying at least 1,000 calories a day for each person;

(xvii) For each two persons the raft is rated to carry, two pints of water or one sea water desalting kit;

(xviii) One fishing kit; and

(xix) One book on survival appropriate for the area in which the aircraft is operated.

(c) [No person may operate an airplane in extended overwater operations unless there is attached to one of the life rafts required by paragraph (a) of this section, an approved survival type emergency locator transmitter. Batteries used in this transmitter must be replaced (or recharged, if the batteries are rechargeable) when the transmitter has been in use for more than 1 cumulative hour, or, when 50 percent of their useful life (or for rechargeable batteries, 50 percent of their useful life of charge) has expired, as established by the transmitter manufacturer under its approval. The new expiration date for replacing (or recharging) 1/6/87); [(Amdt. 135–49, Eff. 6/21/94)]

§ 135.169 Additional airworthiness requirements.

(a) [Except for commuter category airplanes, no person may operate a large airplane unless it meets the additional airworthiness requirements of §§ 121.213 through 121.283 and 121.307 of this chapter.]

(b) No person may operate a reciprocating-engine or turbopropeller-powered small airplane that has a passenger seating configuration, excluding pilot seats, of 10 seats or more unless it is type certificated—

(1) In the transport category;

(2) Before July 1, 1970, in the normal category and meets special conditions issued by the Administrator for airplanes intended for use in operations under this part;

(3) Before July 19, 1970, in the normal category and meets the additional airworthiness standards in Special Federal Aviation Regulation No. 23;

(4) In the normal category and meets the additional airworthiness standards in appendix A;

(5) In the normal category and complies with section 1.(a) of Special Federal Aviation Regulation No. 41;

(6) In the normal category and complies with section 1.(b) of Special Federal Aviation Regulation No. 41; or

(7) In the commuter category.

(c) No person may operate a small airplane with a passenger seating configuration, excluding any pilot seat, of 10 seats or more, with a seating configuration greater than the maximum seating configuration used in that type airplane in operations under this part before August 19, 1977. This paragraph does not apply to—

(1) An airplane that is type certificated in the transport category; or

(2) An airplane that complies with—

(i) Appendix A of this part provided that its passenger seating configuration, excluding pilot seats, does not exceed 19 seats; or

certificated after January 1, 1958, must have ceiling and sidewall panels which are constructed of:

(i) Glass fiber reinforced resin;

(ii) Materials which meet the test requirements of part 25, appendix F, part III of this chapter; or

(iii) In the case of liner installations approved prior to March 20, 1989, aluminum.

(2) For compliance with this paragraph, the term "liner" includes any design feature, such as a joint or fastener, which would affect the capability of the liner to safely contain a fire.

(Amdt. 135–2, Eff. 10/17/79); (Amdt. 135–21, Eff. 2/17/87); (Amdt. 135–31, Eff. 3/20/89); [(Amdt. 135–55, Eff. 3/6/95)]

§135.170 Materials for compartment interiors.

[(a) No person may operate an airplane that conforms to an amended or supplemental type certificate issued in accordance with SFAR No. 41 for a maximum certificated takeoff weight in excess of 12,500 pounds unless within one year after issuance of the initial airworthiness certificate under that SFAR, the airplane meets the compartment interior requirements set forth in §25.853(a) in effect March 6, 1995 (formerly §25.853(a), (b), (b–1), (b–2), and (b–3) of this chapter in effect on September 26, 1978).]

(b) [Except for commuter category airplanes and airplanes certificated under Special Federal Aviation Regulation No. 41, no person may operate a large airplane unless it meets the following additional airworthiness requirements:]*

[(1) Except for those materials covered by paragraph (b)(2) of this section, all materials in each compartment used by the crewmembers or passengers must meet the requirements of §25.853 of this chapter in effect as follows or later amendment thereto:

[(i) Except as provided in paragraph (b)(1)(iv) of this section, each airplane with a passenger capacity of 20 or more and manufactured after August 19, 1988, but prior to August 20, 1990, must comply with the heat release rate testing provisions of §25.853(d)

[(ii) Each airplane with a passenger capacity of 20 or more and manufactured after August 19, 1990, must comply with the heat release rate and smoke testing provisions of §25.853(d) in effect March 6, 1995 (formerly §25.853(a–1) in effect on September 26, 1988).

[(iii) Except as provided in paragraph (b)(1)(v) or (vi) of this section, each airplane for which the application for type certificate was filed prior to May 1, 1972, must comply with the provisions of §25.853 in effect on April 30, 1972, regardless of the passenger capacity, if there is a substantially complete replacement of the cabin interior after April 30, 1972.

[(iv) Except as provided in paragraph (b)(1)(v) or (vi) of this section, each airplane for which the application for type certificate was filed after May 1, 1972, must comply with the material requirements under which the airplane was type certificated regardless of the passenger capacity if there is a substantially complete replacement of the cabin interior after that date.

[(v) Except as provided in paragraph (b)(1)(vi) of this section, each airplane that was type certificated after January 1, 1958, must comply with the heat release testing provisions of §25.853(d) in effect March 6, 1995 (formerly §25.853(a–1) in effect on August 20, 1986), if there is a substantially complete replacement of the cabin interior components identified in that paragraph on or after that date, except that the total heat release over the first 2 minutes of sample exposure shall not exceed 100 kilowatt-minutes per square meter and the peak heat release rate shall not exceed 100 kilowatts per square meter.

[(vi) Each airplane that was type certificated after January 1, 1958, must comply with the heat release rate and smoke testing provisions of §25.853(d) in effect March 6, 1995 (formerly §25.853(a–1) in effect on August 20, 1986), if there is a substantially complete replacement of the cabin interior components

paragraph (b)(1)(i), (b)(1)(ii), (b)(1)(v), or (b)(1)(vi) of this section for specific components of the cabin interior that do not meet applicable flammability and smoke emission requirements, if the determination is made that special circumstances exist that make compliance impractical. Such grants of deviation will be limited to those airplanes manufactured within 1 year after the applicable date specified in this section and those airplanes in which the interior is replaced within 1 year of that date. A request for such grant of deviation must include a thorough and accurate analysis of each component subject to § 25.853(d) in effect March 6, 1995 (formerly § 25.853(a–1) in effect on August 20, 1986), the steps being taken to achieve compliance, and, for the few components for which timely compliance will not be achieved, credible reasons for such noncompliance.

[(viii) Contrary provisions of this section notwithstanding, galley carts and standard galley containers that do not meet the flammability and smoke emission requirements of § 25.853(d) in effect March 6, 1995 (formerly § 25.853(a–1) in effect on August 20, 1986), may be used in airplanes that must meet the requirements of paragraph (b)(1)(i), (b)(1)(ii), (b)(1)(iv), or (b)(1)(vi) of this section provided the galley carts or standard containers were manufactured prior to March 6, 1995.

[(2) For airplanes type certificated after January 1, 1958, seat cushions, except those on flight crewmember seats, in any compartment occupied by crew or passengers must comply with the requirements pertaining to fire protection of seat cushions in § 25.853(c) effective November 26, 1984.]

(Amdt. 135–2, Eff. 10/17/79); [(Amdt. 135–55, Eff. 3/6/95)]; [(Amdt. 135–56, Eff. 3/6/95)]*

§ 135.171 Shoulder harness installation at flight crewmember stations.

(a) No person may operate a turbojet aircraft or an aircraft having a passenger seating configuration, excluding any pilot seat, of 10 seats or more unless it is equipped with an approved shoulder with the shoulder harness fastened.

§ 135.173 Airborne thunderstorm detection equipment requirements.

(a) No person may operate an aircraft that has a passenger seating configuration, excluding any pilot seat, of 10 seats or more in passenger-carrying operations, except a helicopter operating under day VFR conditions, unless the aircraft is equipped with either approved thunderstorm detection equipment or approved airborne weather radar equipment.

(b) [No] person may operate a helicopter that has a passenger seating configuration, excluding any pilot seat, of 10 seats or more in passenger-carry operations, under night VFR when current weather reports indicate that thunderstorms or other potentially hazardous weather conditions that can be detected with airborne thunderstorm detection equipment may reasonably be expected along the route to be flown, unless the helicopter is equipped with either approved thunderstorm detection equipment or approved airborne weather radar equipment.

(c) No person may begin a flight under IFR or night VFR conditions when current weather reports indicate that thunderstorms or other potentially hazardous weather conditions that can be detected with airborne thunderstorm detection equipment, required by paragraph (a) or (b) of this section, may reasonably be expected along the route to be flown, unless the airborne thunderstorm detection equipment is in satisfactory operating condition.

(d) If the airborne thunderstorm detection equipment becomes inoperative en route, the aircraft must be operated under the instructions and procedures specified for that event in the manual required by § 135.21.

(e) This section does not apply to aircraft used solely within the State of Hawaii, within the State of Alaska, within that part of Canada west of longitude 130 degrees W, between latitude 70 degrees N, and latitude 53 degrees N, or during any training, test, or ferry flight.

(f) Without regard to any other provision of this part, an alternate electrical power supply is not

ment requirements.

(a) No person may operate a large, transport category aircraft in passenger-carrying operations unless approved airborne weather radar equipment is installed in the aircraft.

(b) No person may begin a flight under IFR or night VFR conditions when current weather reports indicate that thunderstorms, or other potentially hazardous weather conditions that can be detected with airborne weather radar equipment, may reasonably be expected along the route to be flown, unless the airborne weather radar equipment required by paragraph (a) of this section is in satisfactory operating condition.

(c) If the airborne weather radar equipment becomes inoperative en route, the aircraft must be operated under the instructions and procedures specified for that event in the manual required by § 135.21.

(d) This section does not apply to aircraft used solely within the State of Hawaii, within the State of Alaska, within that part of Canada west of longitude 130 degrees W, between latitude 70 degrees N, and latitude 53 degrees N, or during any training, test, or ferry flight.

(e) Without regard to any other provision of this part, an alternate electrical power supply is not required for airborne weather radar equipment.

§ 135.177 Emergency equipment requirements for aircraft having a passenger seating configuration of more than 19 passengers.

(a) No person may operate an aircraft having a passenger seating configuration, excluding any pilot seat, of more than 19 seats unless it is equipped with the following emergency equipment:

(1) One approved first aid kit for treatment of injuries likely to occur in flight or in a minor accident, which meets the following specifications and requirements:

(i) Each first aid kit must be dust and moisture proof, and contain only materials that either meet Federal Specifications GGK–319a, as revised, or as approved by the Administrator.

Contents	*Quantity*
Adhesive bandage compressors, 1 in ..	16
Antiseptic swabs	20
Ammonia inhalents	10
Bandage compressors, 4 in	8
Triangular bandage compressors, 40 in	5
Arm splint, noninflatable	1
Leg splint, noninflatable	1
Roller bandage, 4 in	4
Adhesive tape, 1-in standard roll	2
Bandage scissors	1
[Protective latex gloves or equivalent nonpermeable gloves	1 pair]

[(iv) Protective latex gloves or equivalent nonpermeable gloves may be placed in the first aid kit or in a location that is readily accessible to crewmembers.]

(2) A crash axe carried so as to be accessible to the crew but inaccessible to passengers during normal operations.

(3) Signs that are visible to all occupants to notify them when smoking is prohibited and when safety belts must be fastened. The signs must be constructed so that they can be turned on during any movement of the aircraft on the surface, for each takeoff or landing, and at other times considered necessary by the pilot in command. ''No smoking'' signs shall be turned on when required by § 135.127.

(4) (Reserved)

(b) Each item of equipment must be inspected regularly under inspection periods established in the operations specifications to ensure its condition for continued serviceability and immediate readiness to perform its intended emergency purposes.

(Amdt. 135–25, Eff. 4/23/88); (Amdt. 135–43, Eff. 6/30/92); (Amdt. 135–44, Eff. 10/15/92); (Amdt. 135–47, Eff. 1/12/94); [(Amdt. 135–53, Eff. 12/2/94)]

§ 135.178 Additional emergency equipment.

[No person may operate an airplane having a passenger seating configuration of more than 19 seats, unless it has the additional emergency equip-

the landing gear extended, must have an approved means to assist the occupants in descending to the ground. The assisting means for a floor-level emergency exit must meet the requirements of § 25.809(f)(1) of this chapter in effect on April 30, 1972, except that, for any airplane for which the application for the type certificate was filed after that date, it must meet the requirements under which the airplane was type certificated. An assisting means that deploys automatically must be armed during taxiing, takeoffs, and landings; however, the Administrator may grant a deviation from the requirement of automatic deployment if he finds that the design of the exit makes compliance impractical, if the assisting means automatically erects upon deployment and, with respect to required emergency exits, if an emergency evacuation demonstration is conducted in accordance with § 121.291(a) of this chapter. This paragraph does not apply to the rear window emergency exit of Douglas DC–3 airplanes operated with fewer than 36 occupants, including crewmembers, and fewer than five exits authorized for passenger use.

[(b) *Interior emergency exit marking.* The following must be complied with for each passenger-carrying airplane:

[(1) Each passenger emergency exit, its means of access, and its means of opening must be conspicuously marked. The identity and location of each passenger emergency exit must be recognizable from a distance equal to the width of the cabin. The location of each passenger emergency exit must be indicated by a sign visible to occupants approaching along the main passenger aisle. There must be a locating sign—

[(i) Above the aisle near each over-the-wing passenger emergency exit, or at another ceiling location if it is more practical because of low headroom;

[(ii) Next to each floor level passenger emergency exit, except that one sign may serve two such exits if they both can be seen readily from that sign; and

[(iii) On each bulkhead or divider that prevents fore and aft vision along the passenger cabin, to indicate emergency exits beyond and obscured by it, except that if this is not possible, the sign may be placed at another appropriate location.

§ 25.812(b) of this chapter in effect on April 30, 1972. On these airplanes, no sign may continue to be used if its luminescence (brightness) decreases to below 100 microlamberts. The colors may be reversed if it increases the emergency illumination of the passenger compartment. However, the Administrator may authorize deviation from the 2-inch background requirements if he finds that special circumstances exist that make compliance impractical and that the proposed deviation provides an equivalent level of safety.

[(ii) For an airplane for which the application for the type certificate was filed on or after May 1, 1972, each passenger emergency exit marking and each locating sign must be manufactured to meet the interior emergency exit marking requirements under which the airplane was type certificated. On these airplanes, no sign may continue to be used if its luminescence (brightness) decreases to below 250 microlamberts.

[(c) *Lighting for interior emergency exit markings.* Each passenger-carrying airplane must have an emergency lighting system, independent of the main lighting system; however, sources of general cabin illumination may be common to both the emergency and the main lighting systems if the power supply to the emergency lighting system is independent of the power supply to the main lighting system. The emergency lighting system must—

[(1) Illuminate each passenger exit marking and locating sign;

[(2) Provide enough general lighting in the passenger cabin so that the average illumination when measured at 40-inch intervals at seat armrest height, on the centerline of the main passenger aisle, is at least 0.05 foot-candles; and

[(3) For airplanes type certificated after January 1, 1958, include floor proximity emergency escape path marking which meets the requirements of § 25.812(e) of this chapter in effect on November 26, 1984.

[(d) *Emergency light operation.* Except for lights forming part of emergency lighting subsystems provided in compliance with § 25.812(h) of this chapter (as prescribed in paragraph (h) of this section) that serve no more than one assist means, are independ-

a normal flight attendant seat;

[(2) Have a means to prevent inadvertent operation of the manual controls;

[(3) When armed or turned on at either station, remain lighted or become lighted upon interruption of the airplane's normal electric power;

[(4) Be armed or turned on during taxiing, takeoff, and landing. In showing compliance with this paragraph, a transverse vertical separation of the fuselage need not be considered;

[(5) Provide the required level of illumination for at least 10 minutes at the critical ambient conditions after emergency landing; and

[(6) Have a cockpit control device that has an "on," "off," and "armed" position.

[(e) *Emergency exit operating handles.*

[(1) For a passenger-carrying airplane for which the application for the type certificate was filed prior to May 1, 1972, the location of each passenger emergency exit operating handle, and instructions for opening the exit, must be shown by a marking on or near the exit that is readable from a distance of 30 inches. In addition, for each Type I and Type II emergency exit with a locking mechanism released by rotary motion of the handle, the instructions for opening must be shown by—

[(i) A red arrow with a shaft at least three-fourths inch wide and a head twice the width of the shaft, extending along at least 70° of arc at a radius approximately equal to three-fourths of the handle length; and

[(ii) The word "open" in red letters 1 inch high placed horizontally near the head of the arrow.

[(2) For a passenger-carrying airplane for which the application for the type certificate was filed on or after May 1, 1972, the location of each passenger emergency exit operating handle and instructions for opening the exit must be shown in accordance with the requirements under which the airplane was type certificated. On these airplanes, no operating handle or operating handle cover may continue to be used if its luminescence (brightness) decreases to below 100 microlamberts.

[(2) There must be enough space next to each Type I or Type II emergency exit to allow a crewmember to assist in the evacuation of passengers without reducing the unobstructed width of the passageway below that required in paragraph (f)(1) of this section; however, the Administrator may authorize deviation from this requirement for an airplane certificated under the provisions of part 4b of the Civil Air Regulations in effect before December 20, 1951, if he finds that special circumstances exist that provide an equivalent level of safety.

[(3) There must be access from the main aisle to each Type III and Type IV exit. The access from the aisle to these exits must not be obstructed by seats, berths, or other protrusions in a manner that would reduce the effectiveness of the exit. In addition, for a transport category airplane type certificated after January 1, 1958, there must be placards installed in accordance with 25.813(c)(3) of this chapter for each Type Ill exit after December 3, 1992.

[(4) If it is necessary to pass through a passageway between passenger compartments to reach any required emergency exit from any seat in the passenger cabin, the passageway must not be obstructed. Curtains may, however, be used if they allow free entry through the passageway.

[(5) No door may be installed in any partition between passenger compartments.

[(6) If it is necessary to pass through a doorway separating the passenger cabin from other areas to reach a required emergency exit from any passenger seat, the door must have a means to latch it in the open position, and the door must be latched open during each takeoff and landing. The latching means must be able to withstand the loads imposed upon it when the door is subjected to the ultimate inertia forces, relative to the surrounding structure, listed in § 25.561(b) of this chapter.

[(g) *Exterior exit markings.* Each passenger emergency exit and the means of opening that exit from the outside must be marked on the outside of the airplane. There must be a 2-inch colored band outlining each passenger emergency exit on the side of the fuselage. Each outside marking, including the band, must be readily distinguishable

[(2) If the reflectance of the darker color is greater than 15 percent, at least a 30 percent difference between its reflectance and the reflectance of the lighter color must be provided.

[(3) Exits that are not in the side of the fuselage must have the external means of opening and applicable instructions marked conspicuously in red or, if red is inconspicuous against the background color, in bright chrome yellow and, when the opening means for such an exit is located on only one side of the fuselage, a conspicuous marking to that effect must be provided on the other side. "Reflectance" is the ratio of the luminous flux reflected by a body to the luminous flux it receives.

[(h) *Exterior emergency lighting and escape route.*

[(1) Each passenger-carrying airplane must be equipped with exterior lighting that meets the following requirements:

[(i) For an airplane for which the application for the type certificate was filed prior to May 1, 1972, the requirements of § 25.812 (f) and (g) of this chapter in effect on April 30, 1972.

[(ii) For an airplane for which the application for the type certificate was filed on or after May 1, 1972, the exterior emergency lighting requirements under which the airplane was type certificated.

[(2) Each passenger-carrying airplane must be equipped with a slip-resistant escape route that meets the following requirements:

[(i) For an airplane for which the application for the type certificate was filed prior to May 1, 1972, the requirements of § 25.803(e) of this chapter in effect on April 30, 1972.

[(ii) For an airplane for which the application for the type certificate was filed on or after May 1, 1972, the slip-resistant escape route requirements under which the airplane was type certificated.

[(i) *Floor level exits.* Each floor level door or exit in the side of the fuselage (other than those leading into a cargo or baggage compartment that is not accessible from the passenger cabin) that is 44 or more inches high and 20 or more inches impractical and that an acceptable level of safety has been achieved.

[(j) *Additional emergency exits.* Approved emergency exits in the passenger compartments that are in excess of the minimum number of required emergency exits must meet all of the applicable provisions of this section, except paragraphs (f)(1), (2), and (3) of this section, and must be readily accessible.

[(k) On each large passenger-carrying turbojet-powered airplane, each ventral exit and tailcone exit must be—

[(1) Designed and constructed so that it cannot be opened during flight; and

[(2) Marked with a placard readable from a distance of 30 inches and installed at a conspicuous location near the means of opening the exit, stating that the exit has been designed and constructed so that it cannot be opened during flight.

[(l) *Portable lights.* No person may operate a passenger-carrying airplane unless it is equipped with flashlight stowage provisions accessible from each flight attendant seat.]

[(Amdt. 135–43, Eff. 6/3/92)]

§ 135.179 Inoperable instruments and equipment.

(a) No person may take off an aircraft with inoperable instruments or equipment installed unless the following conditions are met:

(1) An approved Minimum Equipment List exists for that aircraft.

(2) The [certificate-holding district office] has issued the certificate holder operations specifications authorizing operations in accordance with an approved Minimum Equipment List. The flight crew shall have direct access at all times prior to flight to all of the information contained in the approved Minimum Equipment List through printed or other means approved by the Administrator in the certificate holders operations specifications. An approved Minimum Equipment List, as authorized by the operations specifications, constitutes an approved change to the type design without requiring recertification.

(3) The approved Minimum Equipment List must:

instruments and equipment and the information required by (a)(3)(ii) of this section must be available to the pilot.

(5) The aircraft is operated under all applicable conditions and limitations contained in the Minimum Equipment List and the operations specifications authorizing use of the Minimum Equipment List.

(b) The following instruments and equipment may not be included in the Minimum Equipment List:

(1) Instruments and equipment that are either specifically or otherwise required by the airworthiness requirements under which the airplane is type certificated and which are essential for safe operations under all operating conditions.

(2) Instruments and equipment required by an airworthiness directive to be in operable condition unless the airworthiness directive provides otherwise.

(3) Instruments and equipment required for specific operations by this part.

(c) Notwithstanding paragraphs (b)(1) and (b)(3) of this section, an aircraft with inoperable instruments or equipment may be operated under a special flight permit under §§ 21.197 and 21.199 of this chapter.

(Amdt. 135–39, Eff. 6/20/91); [(Amdt. 135–60, Eff. 2/26/96)]

§ 135.180 Traffic alert and collision avoidance system.

(a) [Unless otherwise authorized by the Administrator, after December 31, 1995, no person may operate a turbine-powered airplane that has a passenger seat configuration, excluding any pilot seat, of 10 to 30 seats unless it is equipped with an approved traffic alert and collision avoidance system. If a TCAS II system is installed, it must be capable of coordinating with TCAS units that meet TSO C–119.]

(b) The airplane flight manual required by § 135.21 of this part shall contain the following information on the TCAS I system required by this section:

(1) Appropriate procedures for—

(Amdt. 135–30, Eff. 2/9/89); [(Amdt. 135–54, Eff. 12/29/94)]

§ 135.181 Performance requirements: Aircraft operated over-the-top or in IFR conditions.

(a) Except as provided in paragraphs (b) and (c) of this section, no person may—

(1) Operate a single-engine aircraft carrying passengers over-the-top or in IFR conditions; or

(2) Operate a multiengine aircraft carrying passengers over-the-top or in IFR conditions at a weight that will not allow it to climb, with the critical engine inoperative, at least 50 feet a minute when operating at the MEAs of the route to be flown or 5,000 feet MSL, whichever is higher.

(b) Notwithstanding the restrictions in paragraph (a)(2) of this section, multiengine helicopters carrying passengers offshore may conduct such operations in over-the-top or in IFR conditions at a weight that will allow the helicopter to climb at least 50 feet per minute with the critical engine inoperative when operating at the MEA of the route to be flown or 1,500 feet MSL, whichever is higher.

(c) Without regard to paragraph (a) of this section—

(1) If the latest weather reports or forecasts, or any combination of them, indicate that the weather along the planned route (including takeoff and landing) allows flight under VFR under the ceiling (if a ceiling exists) and that the weather is forecast to remain so until at least 1 hour after the estimated time of arrival at the destination, a person may operate an aircraft over-the-top; or

(2) If the latest weather reports or forecasts, or any combination of them, indicate that the weather along the planned route allows flight under VFR under the ceiling (if a ceiling exists) beginning at a point no more than 15 minutes flying time at normal cruise speed from the departure airport, a person may—

(i) Take off from the departure airport in IFR conditions "and fly in IFR conditions to a point no more than 15 minutes flying time at normal cruise speed from that airport;

an approach to be completed under VFR.

(d) Without regard to paragraph (a) of this section, a person may operate an aircraft over-the-top under conditions allowing—

(1) For multiengine aircraft, descent or continuance of the flight under VFR if its critical engine fails; or

(2) For single-engine aircraft, descent under VFR if its engine fails.

(Amdt. 135–20, Eff. 1/6/87)

§ 135.183 Performance requirements: Land aircraft operated over water.

No person may operate a land aircraft carrying passengers over water unless—

(a) It is operated at an altitude that allows it to reach land in the case of engine failure;

flotation devices.

§ 135.185 Empty weight and center of gravity: Currency requirement.

(a) No person may operate a multiengine aircraft unless the current empty weight and center of gravity are calculated from values established by actual weighing of the aircraft within the preceding 36 calendar months.

(b) Paragraph (a) of this section does not apply to—

(1) Aircraft issued an original airworthiness certificate within the preceding 36 calendar months; and

(2) Aircraft operated under a weight and balance system approved in the operations specifications of the certificate holder.

Appendix B—Airplane Flight Recorder Specifications

Parameters	*Range*	*Installed system[1] minimum accuracy (to recovered data)*	*Sampling interval (per second)*	*Resolution[4] read out*
Relative time (from recorded on prior to takeoff)	[25 hr minimum]	± 0.125% per hour	1	1 sec
Indicated airspeed	V_{SO} to V_D (KIAS)	± 5% or ± 10 kts., whichever is greater. Resolution 2 kts. below 175 KIAS	1	1%[3]
Altitude	−1,000 ft. to max cert. alt. of A/C	± 100 to ± 700 ft. (see Table 1, TSO C51–a)	1	25 to 150
Magnetic heading	360°	± 5°	1	1°
Vertical acceleration	−3g to +6g	± 0.2g in addition to ± 0.3g maximum datum	4 (or 1 per second where peaks, ref. to 1g are recorded)	0.03g
Longitudinal acceleration	±1.0g	±1.5% max. range excluding datum error of ±5%	2	0.01g
Pitch attitude	100% if usable	±2°	1	0.8°
Roll attitude	±60° or 100% of usable range, whichever is greater	±2°	1	0.8°
Stabilizer trim position	Full range	±3% unless higher uniquely required	1	1%[3]
Pitch control position	Full range	±3% unless higher uniquely required	1	1%[3]
	Engine Power, Each Engine			
Fan or N_1 speed or EPR or cockpit indications used for aircraft certification	Maximum range	±5%	1	1%[3]
Prop. speed and torque (sample once/sec as close together as practicable)			1 (prop speed), 1 (torque)	
Altitude rate[2] (need depends on altitude resolution)	±8,000 fpm	±10%. Resolution 250 fpm below 12,000 ft. indicated	1	250 fpm Below 12,000

pends on altitude resolution)	range			
Radio transmitter keying (discrete)	On/off		1	
TE flaps (discrete or analog)	Each discrete position (U,D, T/O, AAP) or Analog 0–100% range	±3°	1	1 1%[3]
LE flaps (discrete or analog)	Each discrete position (U,D, T/O, AAP) or Analog 0–100% range	1 ±3°	1	1%[3]
Thrust reverser, each engine (discrete)	Stowed or full reverse		1	
Spoiler/speedbrake (discrete)	Stowed or out		1	
Autopilot engaged (discrete)	Engaged or disengaged		1	

[1] When data sources are aircraft instruments (except altimeters) of acceptable quality to fly the aircraft the recording system excluding these sensors (but including all other characteristics of the recording system) shall contribute no more than half of the values in this column.

[2] If data from the altitude encoding altimeter (100 ft. resolution) is used, then either one of these parameters should also be recorded. If however, altitude is recorded at a minimum resolution of 25 feet, then these two parameters can be omitted.

[3] Percent of full range.

[4] This column applies to aircraft manufacturing after October 11, 1991.

Docket No. 25530 (53 FR 26152) Eff. 7/11/88; (Amdt. 135–26, Eff. 10/11/88); [(Amdt. 135–69, Eff. 8/18/97)]

Parameters	*Range*	*Installed system[1] minimum accuracy (to recovered data)*	*Sampling interval (per second)*	*Resolution[3] read out*
Relative time (from recorded on prior to takeoff)	[25 hr minimum]	±0.125% per hour	1	1 sec
Indicated airspeed	$V_m$in to V_D (KIAS) (minimum airspeed signal attainable with installed pilot-static system)	±5% or ±10 kts., whichever is greater	1	1 kt
Altitude	−1,000 ft. to 20,000 ft. pressure altitude	±100 to ±700 ft. (see Table 1, TSO C51-a).	1	25 to 150 ft
Magnetic heading	360°	±5°	1	1°
Vertical acceleration	−3g to +6g	±0.2g in addition to ±0.3g maximum datum	4 (or 1 per second where peaks, ref to 1g are recorded)	0.05g
Longitudinal acceleration	±1.0g	±1.5% max. range excluding datum error of ±5%	2	0.03g
Pitch attitude	100% of usable range	±2°	1	0.8°
Roll attitude	±60% or 100% of usable range, whichever is greater	±2°	1	0.8°
Altitude rate	±8,000 fpm	±10% resolution 250 fpm below 12,000 ft. indicated	1	250 fpm below 12,000
		Engine Power, Each Engine		
Main rotor speed	Maximum range	±5%	1	1%[2]
Free or power turbine	Maximum range	+5%	1	1%[2]
Engine torque	Maximum range	±5%	1	1%[2]
		Flight Control—Hydraulic Pressure		
Primary (discrete)	High/low		1	
Secondary—if applicable (discrete)	High/low		1	

(discrete)				
Autopilot engaged (discrete)	Engaged or disengaged		1	
SAS status—engaged (discrete)	Engaged/disengaged		1	
SAS fault status (discrete)	Fault/OK		1	
		Flight Controls		
Collective	Full range	±3%	2	1%[2]
Pedal position	Full range	±3%	2	1%[2]
Lat. cyclic	Full range	±3%	2	1%[2]
Long. cyclic	Full range	±3%	2	1%[2]
Controllable stabilator position	Full range	±3%	2	1%[2]

[1] When data sources are aircraft instruments (except altimeters) of acceptable quality to fly the aircraft the recording system excluding these sensors (but including all other characteristics of the recording system) shall contribute no more than half of the values in this column.
[2] Per cent of full range.
[3] This column applies to aircraft manufactured after October 11, 1991.

Docket No. 25530 (53 FR 26152) Eff. 7/11/88; (Amdt. 135–26, Eff. 10/11/88); [(Amdt. 135–69, Eff. 8/18/97)]

[The recorded values must meet the designated range, resolution, and accuracy requirements during dynamic and static conditions. All data recorded must be correlated in time to within one second.

Parameters	*Range*	*Accuracy (sensor input)*	*Seconds per sampling interval*	*Resolution*	*Remarks*
1. Time or Relative Time Counts	24 Hrs, 0 to 4095	+/−0.125% Per Hour	4	1 sec	UTC time preferred when available. Counter increments each 4 seconds of system operation.
2. Pressure Altitude	−1000 ft to max certificated altitude of aircraft. +5000 ft	+/−100 to +/−700 ft (see table, TSO C124a or TSO C51a)	1	5′ to 35″	Data should be obtained from the air data computer when practicable.
3. Indicated airspeed or Calibrated airspeed	50 KIAS or minimum value to Max V_{so+} and V_{so} to 1.2 $V_{.D}$	+/−5% and +/−3%	1	1 kt	Data should be obtained from the air data computer when practicable.
4. Heading (Primary flight crew reference)	0−360° and Discrete "true" or "mag"	+/−2°	1	0.5°	When true or magnetic heading can be selected as the primary heading reference, a discrete indicating selection must be recorded.
5.Normal Acceleration (Vertical)	−3g to +6g	+/−1% of max range excluding datum error of +/−5%	0.125	0.004g.	
6. Pitch Attitude	+/−75%	+/−2°	1 or 0.25 for airplanes operated under § 135.152(j)	0.5°	A sampling rate of 0.25 is recommended.
7. Roll Attitude	+/−180°°	+/−2°	1 or 0.5 for airplanes operated under § 135.152(j)	0.5°	A sampling rate of 0.5 is recommended.

chronization reference					provided the CVR/FDR system complies with TSO C124a CVR synchronization requirements (paragraph 4.2.1 ED–55).
9. Thrust/Power on Each Engine—primary flight crew reference	Full Range Forward	+/−2%	1 (per engine)	0.2% of full range	Sufficient parameters (e.g., EPR, N1 or Torque, NP) as appropriate to the particular engine be recorded to determine power in forward and reverse thrust, including potential overspeed conditions.
10. Autopilot Engagement	Discrete "on" or "off"		1		
11. Longitudinal Acceleration	+/−1g	+/−1.5% max. range excluding datum error of +/−5%	0.25	0.004g.	
12a. Pitch Control(s) position (non-fly-by-wire systems)	Full Range	+/−2° Unless Higher Accuracy Uniquely Required	0.5 or 0.25 for airplanes operated under § 135.152(j)	0.2% of full range	For airplanes that have a flight control break away capability that allows either pilot to operate the controls independently, record both control inputs. The control inputs may be sampled alternately once per second to produce the sampling interval of 0.5 or 0.25, as applicable.
12b. Pitch Control(s) position (fly-by-wire systems)	Full Range	+/−2° Unless Higher Accuracy Uniquely Required	0.5 or 0.25 for airplanes operated under § 135.152(j)	0.2% of full range	
13a. Lateral Control position(s) (non-fly-by-wire)	Full Range	+/−2° Unless Higher Accuracy Uniquely Required	0.5 or 0.25 for airplanes operated under § 135.152(j)	0.2% of full range	For airplanes that have a flight control break away capability that allows either pilot to operate the controls independently, record both control inputs. The control inputs may be sampled alternately once per second to produce the sampling intereval of 0.5 or 0.25, as applicable.

		Required	§ 135.152(j)		
14a. Yaw Control position(s) (non-fly-by-wire)	Full Range	+/−2° Unless Higher Accuracy Uniquely Required	0.5	0.2% of full range	For airplanes that have a flight control break away capability that allows either pilot to operate the controls independently, record both control inputs. The control inputs may be sampled alternately once per second to produce the sampling interval of 0.5.
14b. Yaw Control position(s) (fly-by-wire)	Full Range	+/−2° Unless Higher Accuracy Uniquely Required	0.5	0.2% of full range	
15. Pitch Control Surface(s) Position	Full Range	+/−2° Unless Higher Accuracy Uniquely Required	0.5 or 0.25 for airplanes operated under § 135.152(j)	0.2% of full range	For airplanes fitted with multiple or split surfaces, a suitable combination of inputs is acceptable in lieu of recording each surface separately. The control surfaces may be sampled alternately to produce the sampling interval of 0.5 or 0.25.
16. Lateral Control Surface(s) Position	Full Range	+/−2° Unless Higher Accuracy Uniquely Required	0.5 or 0.25 for airplanes operated under § 135.152(j)	0.2% of full range	A suitable combination of surface position sensors is acceptable in lieu of recording each surface separately. The control surfaces may be sampled alternately to produce the sampling interval of 0.5 or 0.25.
17. Yaw Control Surface(s) Position	Full Range	+/−2° Unless Higher Accuracy Uniquely Required	0.5	0.2% of full range	For airplanes with multiple or split surfaces, a suitable combination of surface position sensors is acceptable in lieu of recording each surface separately. The control surfaces may be sampled alternately to produce the sampling interval of 0.5.
18. Lateral Acceleration	+/−1g	+/−1.5% max. range excluding datum error of +/−5%	0.25	0.004g	

		Required			
20. Trailing Edge Flap or Cockpit Control Selection	Full Range or Each Position (discrete)	+/−3° or as Pilot's indicator	2	0.5% of full range	Flap position and cockpit control may each be sampled alternately at 4 second intervals, to give a data point every 2 seconds.
21. Leading Edge Flap or Cockpit Control Selection	Full Range or Each Discrete Position	+/−3° or as Pilot's indicator and sufficient to determine each discrete position	2	0.5% of full range	Left and right sides, or flap position and cockpit control may each be sampled at 4 second intervals, so as to give a data point every 2 seconds.
22. Each Thrust Reverser Position (or equivalent for propeller airplane)	Stowed, In Transit, and Reverse (Discrete)		1 (per engine		Turbo-jet—2 discretes enable the 3 states to be determined Turbo-prop—1 discrete
23. Ground Spoiler Position or Speed Brake Selection	Full Range or Each Position (discrete).	+/−2° Unless Higher Accuracy Uniquely Required	1 0.5 for airplanes operated under § 135.152(j)	0.2% of full range	
24. Outside Air Temperature or Total Air Temperature	−50°C to +90°C	+/−2° C	2	0.3° C	
25. Autopilot/ Autothrottle/AFCS Mode and Engagement Status	A suitable combination of discretes		1		Discretes should show which systems are engaged and which primary modes are controlling the flight path and speed of the aircraft.
26. Radio Altitude	−20 ft to 2,500 ft	+/−2 ft or +/−3% Whichever is Greater Below 500 ft and +/−5% Above 500 ft	1	1 ft +5% above 500 ft	For autoland/category 3 operations. Each radio altimeter should be recorded, but arranged so that at least one is recorded each second.
27. Localizer Deviation, MLS Azimuth, or GPS Lateral Deviation	+/−400 Microamps or available sensor range as installed +/−62°	As installed +/−3% recommended.	1	0.3% of full range	For autoland/category 3 operations. Each system should be recorded but arranged so that at least one is recorded each second. It is not necessary to record ILS and MLS at the same time, only the approach aid in use need be recorded.

Glideslope Deviation	stalled 0.9 to + 30°				ranged so that at least one is recorded each second. It is not necessary to record ILS and MLS at the same time, only the approach aid in use need be recorded.
29. Marker Beacon Passage	Discrete "on" or "off"		1		A single discrete is acceptable for all markers.
30. Master Warning	Discrete		1		Record the master warning and record each "red" warning that cannot be determined from other parameters or from the cockpit voice recorder.
31. Air/ground sensor (primary airplane system reference nose or main gear)	Discrete "air" or "ground"		1 (0.25 recommended.)		
32. Angle of Attack (If measured directly)	As installed	As installed	2 or 0.5 for airplanes operated under § 135.152(j)	0.3% of full range	If left and right sensors are available, each may be recorded at 4 or 1 second intervals, as appropriate, so as to give a data point at 2 seconds or 0.5 second, as required.
33. Hydraulic Pressure Low, Each System	Discrete or available sensor range, "low" or "normal"	+/−5%	2	0.5% of full range	
34. Groundspeed	As installed	Most Accurate Systems Installed	1	0.2% of full range	
35. GPWS (ground proximity warning system)	Discrete "warning" or "off"		1		A suitable combination of discretes unless recorder capacity is limited in which case a single discrete for all modes is acceptable.
36. Landing Gear Position or Landing gear cockpit control selection	Discrete		4		A suitable combination of discretes should be recorded.
37. Drift Angle	As installed	As installed	4	0.1°	

39. Latitude and Longitude	As installed	As installed	4	0.002°, or as installed	Provided by the Primary Navigation System Reference. Where capacity permits latitude/longitude resolution should be 0.0002°.
40. Stick shaker and pusher activation	Discrete(s) "on" or "off"		1		A suitable combination of discretes to determine activation.
41. Windshear Detection	Discrete "warning" or "off"		1		
42. Throttle/power lever position	Full range	+/−2%	1 for each lever	2% of full range	For airplanes with non-mechanically linked cockpit engine controls.
43. Additional Engine Parameters	As installed	As installed	Each engine each second	2% of full range	Where capacity permits, the preferred priority is indicated vibration level, N2, EGT, Fuel Flow, Fuel Cutoff lever position and N3, unless engine manufacturer recommends otherwise.
44. Traffic Alert and Collision Avoidance System (TCAS)	Discretes	As installed	1		A suitable combination of discretes should be recorded to determine the status of—Combined Control, Vertical Control, Up Advisory, and Down Advisory. (ref. ARINC Characteristic 735 Attachment 6E, TCAS VERTICAL RA DATA OUTPUT WORD.)
45. DME 1 and 2 Distance	0–200 NM;	As installed	4	1 NM	1 mile.
46. Nav 1 and 2 Selected Frequency	Full range	As installed	4		Sufficient to determine selected frequency.
47. Selected barometric setting	Full Range	+/−5%	(1 per 64 sec.)	0.2% of full range	
48. Selected altitude	Full Range	+/−5%	1	100 ft.	
49. Selected speed	Full Range	+/−5%	1	1 knot.	
50. Selected Mach	Full Range	+/−5%	1	.01	
51. Selected vertical speed	Full Range	+/−5%	1	100 ft./min.	

path					
54. Selected decision height	Full Range	+/−5%	64	1 ft.	
55. EFIS display format	Discrete(s)		4		Discretes should show the display system status (e.g., off, normal, fail, composite, sector, plan, nav aids, weather radar, range, copy.
56. Multi-function/ Engine Alerts Display format	Discrete(s)		4		Discretes should show the display system status (e.g., off, normal, fail, and the identity of display pages for emergency procedures, need not be recorded.
57. Thrust command	Full Range	+/−2%	2	2% of full range	
58. Thrust target	Full Range	+/−2%	4	2% of full range	
59. Fuel quantity in CG trim tank	Full Range	+/−5%	(1 per 64 sec.)	1% of full range	
60. Primary Navigation System Reference	Discrete GPS, INS, VOR/ DME, MLS, Loran C, Omega, Localizer Glidescope		4		A suitable combination of discretes to determine the Primary Navigation System reference.
61. Ice Detection	Discrete "ice" or "no ice"		4		
62. Engine warning each engine vibration	Discrete		1		
63. Engine warning each engine over temp.	Discrete		1		
64. Engine warning each engine oil pressure low	Discrete		1		
65. Engine warning each engine over speed	Discrete		1		

		Required			
67. Roll Trim Surface Position	Full Range	+/−3% Unless Higher Accuracy Uniquely Required	2	0.3% of full range	
68. Brake Pressure (left and right)	As installed	+/−5%	1		To determine braking effort applied by pilots or by autobrakes.
69. Brake Pedal Application (left and right)	Discrete or Analog "applied" or "off"	+/−5% (Analog)	1		To determine braking applied by pilots.
70. Yaw or sideslip angle	Full Range	+/−5%	1	0.5°	
71. Engine bleed valve position	Discrete "open" or "closed"		4		
72. De-icing or anti-icing system selection	Discrete "on" or "off"		4		
73. Computed center of gravity	Full Range	+/−5%	(1 per 64 sec.)	1% of full range	
74. AC electrical bus status	Discrete "power" or "off"		4		Each bus
75. DC electrical bus status	Discrete "power" or "off"		4		Each bus
76. APU bleed valve position	Discrete "open" or "closed"		4		
77. Hydraulic Pressure (each system)	Full range	+/−5%	2	100 psi	
78. Loss of cabin pressure	Discrete "loss" or "normal"		1		
79. Computer failure (critical flight and engine control systems)	Discrete "fail" or "normal"		4		

81. Para-visual display (when an information source is installed)	Discrete(s) "on" or "off"		1		
82. Cockpit trim control input position—pitch	Full Range	+/−5%	1	0.2% of full range	Where mechanical means for control inputs are not available, cockpit display trim positions should be recorded.
83. Cockpit trim control input positions—roll	Full Range	+/−5%	1	0.2% of full range	Where mechanical means for control inputs are not available, cockpit display trim positions should be recorded.
84. Cockpit trim control input position—yaw	Full Range	+/−5%	1	0.2% of full range	Where mechanical means for control inputs are not available, cockpit display trim positions should be recorded.
85. Trailing edge flap and cockpit flap control position	Full Range	+/−5%	2	0.5% of full range	Trailing edge flaps and cockpit flap control position may each be sampled alternately at 4 second intervals to provide a sample each 0.5 second.
86. Leading edge flap and cockpit flap control position	Full Range or Discrete	+/−5%	1	0.5% of full range	
87. Ground spoiler position and speed brake selection	Full Range or discrete	+/−5%	0.5	0.2% of full range	

trol column, rudder pedal)	lbs. Control Column +/−85 lb Rudder pedal +/−165 lbs				function of the displacement of the control input device only, it is not necessary to record this parameter. For airplanes that have a flight control break away capability that allows either pilot to operate the control independently, record both control force inputs. The control force inputs may be sampled alternately once per 2 second to produce the sampling interval of 1.]

[(Amdt. 135–69, Eff. 8/18/97)